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The International Journal of Orthodontia Oral Surgery and Radiography

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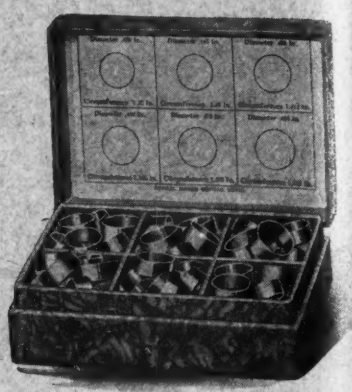

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VOL. XIV ST. LOUIS, NOVEMBER, 1928 No. 11

ORIGINAL ARTICLES

PRESIDENT'S ADDRESS*

BY WALTER H. ELLIS

TWENTY-FIVE years ago the third annual meeting of our Society, the only orthodontic society in the world at that time, met here in Buffalo at the Iroquois Hotel, for its third annual meeting, January 1, 1904. There were about fifteen in attendance. At that time we had fifty members and there were only twelve exclusive practitioners of orthodontia in the world. In 1900 there were only five. The object of the Society at that time was a more firm establishment and recognition of orthodontia as a distinct specialty. President Watson said in his address at that meeting that he looked forward to the time when orthodontia would become a thoroughly and widely established successful specialty. Dr. Edward H. Angle, our founder, said that he felt that only in the environment as found in such a Society as this, could the furtherance of the highest interests of orthodontia in scientific research, in theory and in practice, be engendered. We certainly owe to Dr. Angle a great debt of gratitude for his keen vision at that early day in the development of our specialty and also for all his labor for the advancement of orthodontia. What a contrast compared to today when our Society returns to Buffalo for the first time since those days. We now have 340 members. There are fifteen national and sectional societies in America and many local societies. There are at least seven prominent orthodontic societies abroad. The number practicing orthodontia as exclusive practitioners is already too many to enumerate accurately, there being about one to one hundred thousand of population in our urban communities. Orthodontia is known and recognized as a specialty. Our problem today is not how to broaden the field but to better educate the young men coming into orthodontia and to help broaden

*Read at the meeting of American Society of Orthodontists, Buffalo, N. Y., April 30-May 2, 1928.

the vision of the older men that we may better carry on our obligation and service to humanity. It is fitting that we return to Buffalo to emphasize our progress and observe our accomplishments. Yet, it should humble us as well when we think of the many unsolved problems that confront us and realize that the next twenty-five years must be even fuller of accomplishment. It is gratifying to look back and a stimulatiou to look forward.

We should consider more seriously than we have in the past the public service relations of orthodontia, that is, our obligation to humanity and the problem of the child in its broad sense. Our specialty has not functioned in this respect as effectively as its real importance as one of the vital factors of public health warrants. Orthodontists on the hospital staffs of our children's hospitals should be enabled, by adequate support, to carry on clinics. The usefulness to the public of the college orthodontic clinics could be enlarged. The orthodontic clinics as conducted at the Forsyth and Eastman Infirmaries could to advantage be paralleled in many other cities throughout the land. Several of our members have such plans under way. They should be encouraged morally and financially. The establishment of such a field for usefulness to humanity in your own city would bring dividends of health and happiness to thousands of dear little children, where now you serve only a few score. In this connection, however, we must remember that the defects of the mouth and teeth are problems in the child's whole physical economy—the whole child, mental as well as physical and also the home environmental contacts. Orthodontia is not correction alone, it is preventive also. When we consider this thoughtfully, we realize that the child clinics should not be too circumscribed in scope to be of any real service from a humanitarian aspect. The staff of such clinics should see clearly the problems of all other phases of medicine and get an adequate appreciation of the whole body. Orthodontia for the middle class is a problem yet not as serious as thought by some. The education of a large number of specialists is the logical solution, yet much can be done by the fuller cooperation of the general practitioner. Too few of us see and feel, in a big way, the real humanitarian obligation to the masses, of the professional man.

I am glad to see that orthodontic education, one of our real problems today, is seriously being considered by the profession throughout the land. I trust that this discussion will help to bring about a more stable condition with more uniform methods of practice. We need more well educated men of broad vision to take up orthodontia as a life work.

There has been as yet, no very generally accepted plan of teaching these men. The vital necessity that the well-trained orthodontists have such a broad vision of basic biologic principles and that his training does not overemphasize appliance technic, means that his education must be wisely guided by the older experienced men, those who really know. The obligation, the duty is definitely ours. The solution would seem to be here in this society; if not here, where?

I would suggest that we have a standing committee of orthodontic education whose duty would be to work out a constructive program, reporting

each year in such a way as to coordinate this Society with other groups and individuals who are at present working in this field.

Further advancement of orthodontia is largely dependent on progress in education. Whether this orthodontic training be collegiate, emphasizing medical or dental training; postgraduate; association with an older practitioner of orthodontia or a combination of these plans, is worthy of discussion. I am certain, however, that orthodontia is inseparably allied with the practice of general medicine and the fundamental sciences. This association is being increasingly emphasized in education as well as in practice. Radical changes in medical as well as dental education are necessary to properly train the specialist. The general fundamental education for all special branches should be the same. First, a full, liberal arts and scientific education; second, the basic medical education giving the M.D. This to be followed by the special course in any one of the specialties selected by the student for his life work, be it orthodontia, surgery, ophthalmology or stomatology. Some distinctive examination by the State Board or National Examining Board given in each branch would naturally follow. However, the technical pedagogic methods as relating to the various specialties must be left to the teacher in these branches. We can only suggest or outline in a general way. I would, however, particularly emphasize the full liberal collegiate education. We would then have more of the cultural and the classical in our educational structure.

If the utilitarian phases of professional education shut out academic scholarship we lose the very foundation of learning, the capacity to interpret the phenomena and the power to express the findings of science. The work of the half-educated orthodontist frequently surpasses his ability to express himself in clear and precise words. He may seem to know a great deal but not anything very well. Education is not necessarily a matter of college degrees either. Some of the best educated spent but little time in a university. Degrees do not insure an education to the recipient. It is the man himself; his character, his ability to think, to study, to read, to grow in a broad big way that counts most in his development. Character is the father of ethics. Character, sound mental worth and reverence for the truth tell in our work. We get out of our work, after all, only what we put into it. We should all cultivate literature, music, and so forth and love Nature in her manifold beauties. Our life in this complicated social structure of today can be too busy, hectic, if we let it. We should not use all of it in doing things, we should use some of it to accomplish a little independent thinking. True happiness comes to him who has a home life as the real center of his interests, a vocation he loves with some leisure time to be used wisely. Our education, our cultural life, should extend through all our years, so as we go down the sunset slope of life we may be possessed of a mental competence as well as financial. The inside should be as safe and comfortable as the outside. If it is, we will then have a sound philosophy with which to face old age.

The real progress of orthodontia is so linked up with scientific research that our Society should adopt a definite scientific research program.

Even such a practical master as Industry has found it profitable, as evi-

denced in the fact that the National Research Council announces that 95 per cent of the total income of the present day Americans may be traced to the earnings of processes, industries or products which are based on the results of scientific research. The continuation of American prosperity itself will be largely affected by our success or failure in supporting further research work and utilizing its results. The standards of living for all our people depend almost wholly upon the advance of knowledge.

The medical research worker, however, is not interested in any of these money rewards. He is a purely experimental scientist, a socially minded individual whose aspiration is an altruistic one, happy only in advancing the well-being of humanity. However, it is the scientist working with ample funds and a free mind who alone can advance the knowledge of nature upon which our welfare depends. He needs but opportunity to live and work. He cannot work alone as the day of the struggling genius is past. Research must have well equipped laboratories, associates to do routine work and a background of scientific knowledge to build upon the work of others who have gone before. Real results will come only from well organized work conducted in such an environment. This means endowment. We could do no better than to take our problems to the Research Laboratories of our universities, state or nation, and by endowment get them under way in a business-like manner. Each dollar thus spent will go further than several spent in more isolated plans. There will be many negative results from our research but they will be nearly as valuable as the positive findings.

We have a Research Committee which was authorized a year ago, now serving its first year; I am sure much good will result from their deliberations and recommendations and the discussion incident to their report. This committee consists of five members and will have reported to them all research that is being carried on by members of the American Society of Orthodontists and others for the purpose of record and of recommendation to the Society for aid and assistance to such research as seems to be of value to the orthodontic profession. The resolution empowering this committee stated that the "committee" was to suggest important orthodontic research to the Research Committee of the N. D. A. for their financial support. At first it did seem wise to those in touch with the situation to proceed with such a request for the N. D. A. support for a work already under way on the Pacific Coast. However, considerable opposition to such a request, at that time, developed for the reason that the grant did not seem assured without first supporting it ourselves and that its support by orthodontists already seemed assured for at least the first year; also because we would relinquish prior rights for publication and possibly the interpretation of the findings of this research were the N. D. A. to take it over. Because of this situation, the majority of our Research Committee finally asked that such a request not be made for at least a year. The committee itself being opposed, there was nothing else to do than to defer the request for a grant.

Also, our members, who were also members of the House of Delegates of the N. D. A., were instructed by these resolutions to use their influence in ob-

taining financial support for such research only as is recommended by the A. S. O. Inasmuch as this Pacific Coast Research had not as yet been recommended by our Society, it was thought best to bring it to you for your consideration before going outside of the orthodontic fold for assistance.

Your president, in so interpreting the powers of the Research Committee and in asking that they, under these circumstances, report back to the Society before going further, did not mean that he was opposed to this particular research. It was merely a necessity. Those most interested in the success of this work concurred in this decision. We are favorable to this research and have contributed financially to its support. In any event, our support of it within our specialty will be an impressive recommendation to outside agencies for their assistance should you so decide to instruct your committee.

This committee will, in their report given at this meeting, present some definite policy which will better identify us in this most important work. I hope it will embody recommendations relative to the authoritative handling of research by our Society, the raising and administration of funds and the best methods of conducting the reasearch. This program will of course need funds. The Society must support it adequately in a way worthy of its place in our scientific progress.

The scientific work of this Society is of the utmost value to us, the members, by reason of the part we take as participants in its sessions. Similar value should accrue to the profession at large, but does it? As a matter of fact, our transactions, both as published periodically in the Journal and the bound volumes of transactions, reach few more than the actual membership plus those general practitioners and specialists working in closely related fields who subscribe to the specialist Journal publishing our transactions. This is all very well. However, there is a large field of many thousands, consisting of dentists and physicians, with their many special departments, who should receive the educational value of the material which is brought out at our meetings. Our transactions should be published in other journals with a large circulation. Our agreement with the present publishers has given us this privilege but it has not been exercised. I do not mean to suggest that our transactions be taken from the journal now publishing them. Their cooperation and generosity are much appreciated by all those familiar with the facts, but I do recommend that our Board of Censors take steps to have it published also in a journal whose circulation reaches large numbers of those in general practice. They are totally unaware of the increasingly important scientific facts brought out at our meetings which are also of equal importance to them in their fields.

I wish to make several recommendations relative to the business of the Society. These are not mere opinions or new ideas but come from the intimate knowledge of the Society gained in the several years I have served you as an officer.

I would recommend that our by-laws be changed so as to take the general business off the floor of the Society at large and put it into the hands of the executive committee or a special body, possibly a council, elected for this

purpose. Such a change will meet with opposition but I predict that it will come at a much earlier date than possible opponents now think.

Each year a large mass of business creeps into the program and uses time that should and does rightfully belong to the scientific discussions. The members come to our meetings not to transact business but to take part in the scientific sessions. Our scientific program is getting longer and more important each year and the business equally heavy. The real function of our Society is furtherance of scientific knowledge and to serve humanity.

The only solution of what is becoming a problem is to elect officers in whom you place full confidence. Give them discretionary powers and allow them thus to use to good advantage the abundant experience gained in the Society affairs. A small group could expeditiously and intelligently transact business that a large body takes many times longer to handle. Such meetings should be open to the members and the officers should report back to the Society in such a way as to give it the vote in certain important matters.

I am not suggesting that this change be made at once, unless you think it wise, but I do want you to think about it seriously and remember that it must and will come eventually.

I suggest that the finances of our Society be put on a budget. Expenditures would then be so scheduled as to put our finances on a more business-like basis. The Board of Censors would, under this plan, know just the amount available for essayists, entertainment, banquet, secretarial, overhead, research and also other important matters not strictly within our usual Society expenditures. The funds for each of these Society expenses could be wisely and considerably increased. The honorarium of the secretary-treasurer should be increased so that the full stenographic and secretarial expense could be paid by the Society.

We have had many opinions expressed in the last few years relative to our dues and expenditures. With a budget, we could deal with facts alone. If we have any vision whatever of our responsibilities of today and tomorrow in the adequate financing of our increasingly expensive and important meetings and to lay out a forward-looking program for the future meetings, it will be necessary for our Society to increase its income.

When an adequate budget is adopted, I predict that the annual dues will have to be increased to at least twenty-five dollars, fifteen of this anyway to go into the general Society fund to be expended under this budget and ten dollars could to advantage go into a research fund to be expended only by vote of the Society following the recommendation of the Research Committee.

A bulletin might be published if thought advisable and other measures taken for our Society to function throughout the year in matters of scientific research, education, standards of practice, interrelations with other societies and scientific bodies. Our librarian should also have funds available for his correspondence and orthodontic exchange and make his department a real feature of our society work.

I recommend that a committee be appointed at this meeting that will, after going over the whole situation carefully, lay out such a budget and report back for the Society's action at the next annual meeting.

Some years ago there was a classification of associate members in the Society consisting of those not in exclusive practice. Since then the Society voted to cease electing associates. From time to time, the associates have, as they went into exclusive practice, been transferred to active membership until now we have remaining only four associates who are in somewhat an ambiguous and prominent position, there being no mention of this class in the constitution and by-laws. I recommend that the by-laws be suspended so that these men may be transferred to active membership even though they are not in exclusive practice, thus giving us only one class of members, which I assume was what the Society wished when they ceased electing the associates.

I would like to see some more adequate and uniform method for the official recognition of anyone about to specialize, than pertains at present. I express this with the thought of not only protecting the public but possibly the young man from his own egotism. The State Boards, with one possible exception, as yet have done nothing. We all know that only the expertly trained have a moral right to practice orthodontia; certainly only those who have received a special training of a standard that we all recognize, should be entitled to specialize.

It occurs to me that our Society might have a credentials committee whose duty would be to pass upon the qualifications of anyone about to specialize and wishing an authoritative testimonial attesting worthiness. This committee would function in such a way as to protect the applicant, the orthodontist and the public. Any one wishing for recognition as a specialist should make application to this committee before he makes public announcement of his specialization, and the committee would report favorably or otherwise. If negative, certain suggestions could be made, which disqualification, if corrected, would entitle the applicant to our certificate. This certificate would, in certain instances, make for better preparation and higher ideals, and also give the general practitioner a basis upon which to pass judgment as to the competence of the new specialists as they come along. It would also stimulate the young man to be worthy of this preliminary credential which he would use before he became eligible to membership. Membership, which is of itself a credential, comes only after three years of successful specialization.

I would also suggest that qualifications for membership in our Society be enlarged somewhat from three years of specialization to the presentation of further evidence of fitness, say a thesis, which would give, not only an idea of the applicant's present ability as a specialist, but if a young man, his capacity for the further development of his faculties. A younger applicant of necessity need not compare with his elder colleagues in ability or experience but he should show evidence of moral, professional, and mental equipment that would make him a worthy member of our Society. Such theses, as presented, should be published if acceptable.

I would suggest also that the by-laws be changed so that a candidate, not only as at present, must have been a specialist for three years, but that he remain so to hold his membership. This, however, would not apply to any of our present members who, for any reason, have ceased to specialize.

With our membership thus guarded we would all prize it still more and its insignia would outrank that of any honorary group now open, or might be established in the future, to honor or recognize orthodontists.

I would like to have our Society dedicate itself anew to the extension and advancement of orthodontic science. I would have it a place where truth and righteousness prevail, harmony reigns and nothing mean or petty may live, a haven where no politics or self-exploitation may enter; no personal antagonism present; where all have a due respect for and appreciation of our confrères within and without the Society; every member thinking of, not what the Society is to give, but what he can give the Society and where everyone may have abundant opportunity for not only advancing himself but helping the further progress of our beloved specialty as well.

I wish to fully acknowledge the Society's debt to the essayists, clinicians, those who present case reports and those who enter into any of our discussions. We, the members and guests, in turn, promise you full attendance, closest attention and application in our work, of the truths which you bring to us.

I would express our appreciation for the whole-hearted cooperation and fine spirit with which each member of the Executive Board has functioned this year and particularly are we indebted to the Board of Censors for its preparation of the program.

I wish also to take this opportunity to express my gratitude to my friends and confrères here in Buffalo and the vicinity for the unusually fine and cooperative spirit they have shown in all our preparations for this meeting. The first meeting, at my home, of the seven Buffalo orthodontists, resulted in the formation of the Buffalo Academy of Orthodontia. I would recommend similar organizations in every city where several orthodontists practice.

We deeply appreciate the cooperation and full attendance of all our members, also of our sectional orthodontic societies, coming to Buffalo as they have, in practically 100 per cent groups.

Aside from the scientific importance of our meeting, they also bring to us all much valued and very dear personal associations. These friends we make and keep here with men of common education, experience and aims, getting stronger with the passing years, as they do, mean more to us than any other associations outside of our family life.

That you, my friends and fellow members of this Society, have chosen me President, has given me the proudest and happiest of professional years. I hope my efforts to serve you and our Society may be accepted as a small contribution in payment of the great debt I owe you and my specialty. I only hope that your enjoyment and the stimulation gained from this meeting may be half as great as the pleasure we have had in the preparation for it and the hospitable spirit we, of Buffalo, feel in having you here.

RECOVERY OF SECOND MANDIBULAR MOLAR AFTER COLLAPSE IN SPACE MADE BY EARLY EXTRACTION OF FIRST MOLAR BRINGING SECOND MOLAR INTO POSITION OCCUPIED BY FIRST MOLAR AND MAKING ROOM FOR IMPACTED THIRD MOLAR*

By William C. Fisher, New York, N. Y.

IN REPORTING this case I desire to exhibit it as an example of the benefit of orthodontic interference in young adult cases which have had, because of previous necessary surgical operations, an otherwise ideally normal alignment and occlusion of teeth, seriously disturbed.

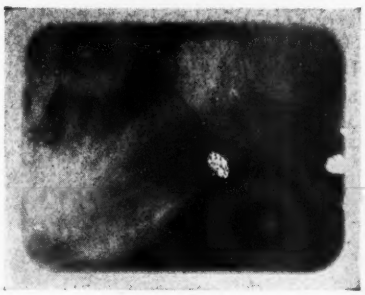


Fig. 1.

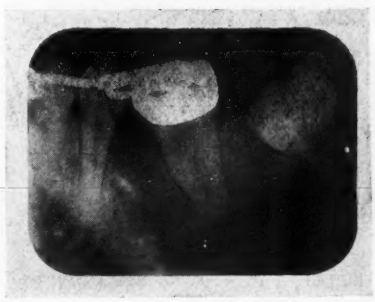


Fig. 2.

Fig. 3.

You will notice from the x-rays and models of this case (Figs. 1 and 3) that the second mandibular molar, even at the age of sixteen years, had partially collapsed into the space made by the extraction of the first molar and the third molar was apparently developing an impaction. The eruption of the third molar which would probably have occurred within the next four or five years would have completed the collapse of the second molar and the positions of both teeth would naturally have been very unsatisfactory from the standpoint of occlusion.

You who have been in general practice for any length of time have observed what a vulnerable spot a tilted molar is for pyorrheal conditions. We considered orthodontic interference at this time justified and the result we were able to obtain has practically prevented the development of a pocket at

*Case report read before the American Society of Othodontists, May 1, 1928, Buffalo, N. Y.

the anterior border of the second molar. In addition to bringing the second molar into a satisfactory occlusion and having it take the space previously occupied by the first molar we probably have removed any third molar complications in that region, for the x-ray now shows that the third molar will have more than ample room for eruption. (Fig. 2.)

Fig. 4.

Fig. 5.

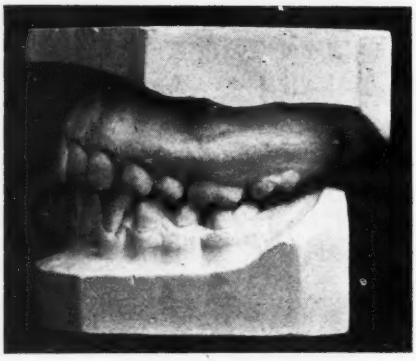


Fig. 6.

Fig. 7.

Fig. 3 shows buccal views of mutilated side before and after treatment.
Fig. 4 shows occlusal views before and after treatment.
Figs. 5 and 6 show models in occlusion before and after treatment.
Fig. 7 shows the diagram of appliances used.

Before attempting to draw the second molar forward into the space formerly occupied by the first molar, we directed our attack to its collapsed condition and brought the molar into the occlusal plane which it would have occupied had the first molar not been removed. After this was accomplished we then applied force both lingually and buccally to bring the molar forward using the buccal arch (17 gauge) as a track upon which to slide the open buccal tube which was attached to the banded molar. Small elastics were used on the lingual hooks as shown in the illustration and also buccally from a hook on the labial arch opposite the canine, and extending posteriorly around the open buccal tube. It was quite some months after we had instituted the elastic force that we were able to see any results; in other words,

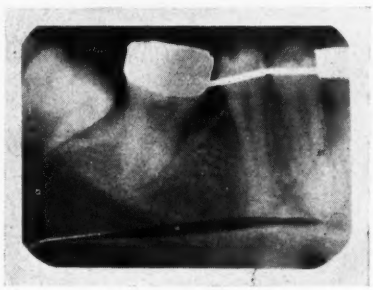


Fig. 8.

Fig. 9.*

the character of tissue in the socket formerly occupied by the first molar was such as to resist tooth movement more than we find in undisturbed or unmutilated alveolar processes.

Fig. 8 shows an x-ray of the case one year after the condition seen in Fig. 2. Retention between second molar and canine on that side is still maintained.

The duration of treatment was one year.

The general dentist who referred this case for treatment states that, in his opinion, this character of malocclusion justifies the institution of orthodontic interference in any and all such cases rather than to wait until late adult life and attempt (after mutilation of good tooth material) the placing of bridge work in order to give the proper occluding surface, and this statement is from one who is considered by his fellow-practitioners an expert in prosthetic dentistry.

*Fig. 9 shows an x-ray of the case one year after the removal of all appliances. The third molar is just appearing above the gum line and according to the picture will take a favorable position in the line of occlusion.

THE PHYSIOLOGIC PROGRESS OF THE BONE CENTERS OF THE HANDS OF NORMAL CHILDREN BETWEEN THE AGES OF FIVE AND SIXTEEN INCLUSIVE; ALSO A COMPARATIVE STUDY OF BOTH RETARDED AND ACCELERATED HAND GROWTH IN CHILDREN WHOSE GENERAL SKELETAL GROWTH IS SIMILARLY AFFECTED*

By Clinton C. Howard, D.D.S., Atlanta, Georgia

Orthodontist to The Good Samaritan (Endocrine) Clinic, and The Scottish Rite Hospital for Crippled Children

THE study of bone growth in the hand, indicative of general skeletal growth, is a fascinating theme. Our interest in the subject was aroused by observation with abnormal children during the past five years at The Good Samaritan (Endocrine) Clinic of Atlanta. At this institution each physical examination includes an x-ray picture of the patient's hand, offering a correlated study of bone growth, which was of such interest as to prompt us to extend our investigation to the normal child. For this purpose we went into the Atlanta public schools and studied the physiologic progress of the ossification centers of the hands of *normal* (the word "normal" is used figuratively throughout this paper) children between the ages of five and sixteen. This study of the abnormal and normal child afforded us an interesting comparative study of hand growth in children whose general skeletal growth was accelerated or retarded.

In a previous report on the study of seven hundred hands,[1] we used as a basis for normal study the classification of Cohn in his *Normal Bones and Joints.*[2] Although his work was exceedingly helpful in establishing the physiologic appearance of the bones of the hand at different ages, several omissions detracted from the value of his conclusions. For example, the number of roentgenographic studies for each chronologic age was not given; the normal advancement of osseous growth in the female as compared to the male (which progressively increases with age from birth to maturity[3]) was not considered; and a statement of the general physical condition of each group was also omitted.

Before the actual survey in this work was begun, a systematic plan was formulated. Environment was first considered. Only those schools were

*Read before the American Society of Orthodontists, Buffalo, N. Y., May, 1928.

selected in which the greatest number of normal children had been classified by the City Health Department. The records of the medical survey included, among other data, the age, sex, weight, height, and any abnormalities of each child. Both hands were radiographed and the number of each radiogram was made to correspond to the number of the child's health-card, practically eliminating the possibility of error in the final tabulation. This survey of normal children began in February and ended in April of this year.

We x-rayed the hands of fifty boys and fifty girls from the ages of five to sixteen inclusive. The total number of pictures made at the public schools amounted to 1412. Some of the groups of normal children ran as high as sixty-eight for each sex. Even though a careful check was made, more than one hundred radiograms were discarded due to various physical defects. One thousand hand pictures already on record at The Good Samaritan Clinic gave ample material for studying abnormal variations. The total number of roentgenographic studies upon which this report is based, therefore, amounts to 2,412 people.

ADOLESCENT INFLUENCE UPON BONE PROGRESS

The advent of pubescence exerts a controlling influence upon bone progress. Our studies are conclusive in demonstrating a marked acceleration in the carpus and epiphyses during the period of adolescence as compared to the pre- and postadolescent ages. Concerning the average age for onset of puberty Eden and Lockyer[4] say: "The age of commencement for menstruation in white women of the United States and Canada has been investigated by Englemann, who, from the data of 20,000 cases, placed the average age at fourteen. Under the various climatic conditions found between the Hudson Bay and the Gulf of Mexico, the writer found very little variation in the time of onset of menstruation. From Englemann's observations it appears that climate is of less importance than race, and the often-expressed opinion that in cold countries women begin to menstruate later than in hot countries cannot be maintained. Thus the negresses of Somaliland begin at sixteen, the women of the Arctic Indians at twelve and a half; but in India and Samoa menstruation begins early, and the first pregnancy often occurs at the age of twelve. While the average age for European races may be regarded as fourteen, the limits of normal puberty must be placed a good deal wider than this, viz., from twelve to sixteen years."

From the evidence just quoted we are led to believe that the normal status of physiologic hand growth which we are demonstrating will apply in all of North America, as well as some countries in Europe.

The record opposite each group of pictures following is self-explanatory.

PLATE I

ROENTGENOGRAPHIC FINDINGS—AGE FIVE, MALE

Number of carpals found	21 had 4
	9 had 5
	12 had 6
	8 had 7

The epiphysis of the radius was present in all cases.

Six cases presented an epiphysis of the ulna.

There was no thickening of any epiphysis of the ulna to indicate the growth of the styloid process.

Sesamoid bones were absent in all cases.

ROENTGENOGRAPHIC FINDINGS—AGE FIVE, FEMALE

Number of carpals found	4 had 3
	2 had 4
	2 had 5
	4 had 6
	38 had 7

The epiphysis of the radius was present in all cases.

Fourteen cases presented an epiphysis of the ulna.

There was no thickening of any epiphysis of the ulna to indicate the growth of the styloid process.

Sesamoid bones were absent in all cases.

PLATE I.

PLATE II

ROENTGENOGRAPHIC FINDINGS—AGE SIX, MALE

Number of carpals found	3 had 3
	9 had 4
	7 had 5
	9 had 6
	22 had 7

The epiphysis of the radius was present in all cases.

Fourteen cases presented an epiphysis of the ulna.

There was no thickening of any epiphysis of the ulna to indicate the growth of the styloid process.

Sesamoid bones were absent in all cases.

ROENTGENOGRAPHIC FINDINGS—AGE SIX, FEMALE

Number of carpals found	2 had 4
	1 had 5
	5 had 6
	41 had 7
	1 had 8

The epiphysis of the radius was present in all cases.

Thirty-six cases presented an epiphysis of the ulna.

One case showed (the one with eight carpals) a modified styloid process of the ulna.

Sesamoid bones were absent in all cases.

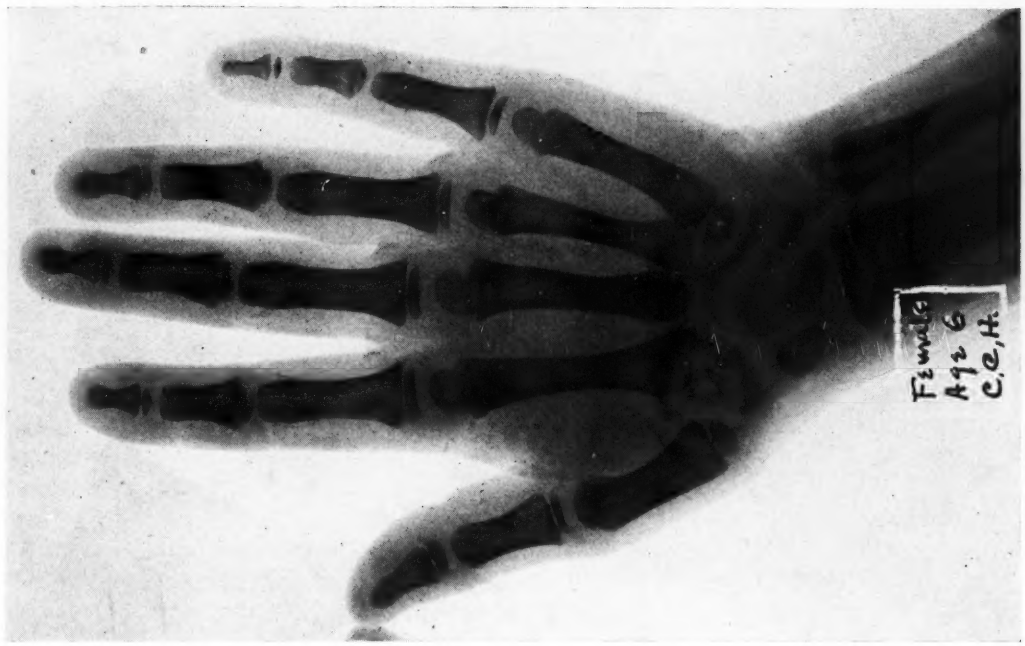


PLATE II.

PLATE III

ROENTGENOGRAPHIC FINDINGS—AGE SEVEN, MALE

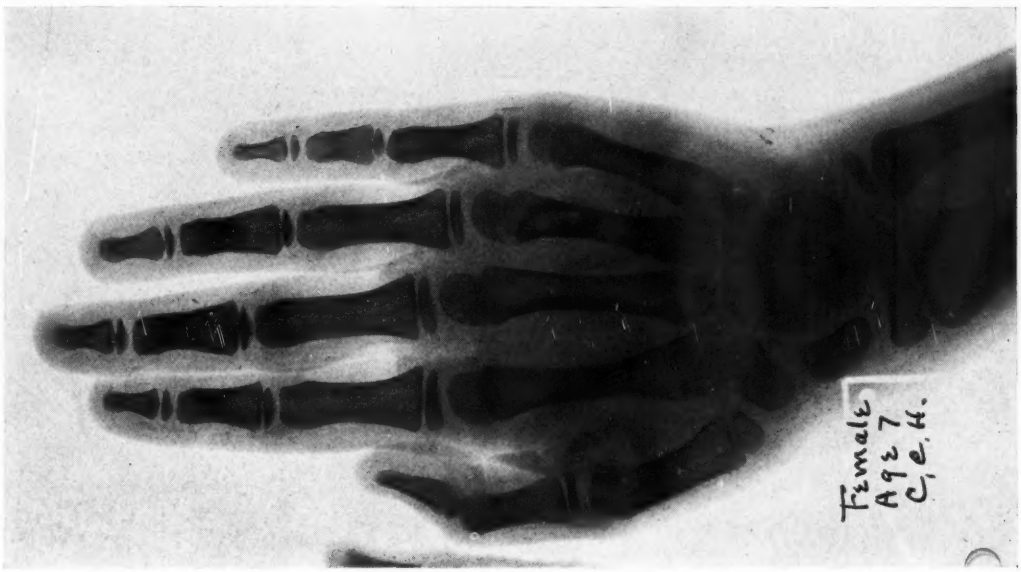
Number of carpals found
- 1 had 3
- 4 had 4
- 3 had 5
- 3 had 6
- 39 had 7

The epiphysis of the radius was present in all cases.
Thirty-six cases presented an epiphysis of the ulna.
Three cases presented a modified styloid process of the ulna.
Sesamoid bones were absent in all cases.

ROENTGENOGRAPHIC FINDINGS—AGE SEVEN, FEMALE

Number of carpals found
- 46 had 7
- 4 had 8

The epiphysis of the radius was present in all cases.
Forty-six cases presented an epiphysis of the ulna.
Seven cases presented a modified styloid process of the ulna.
Sesamoid bones were absent in all cases.



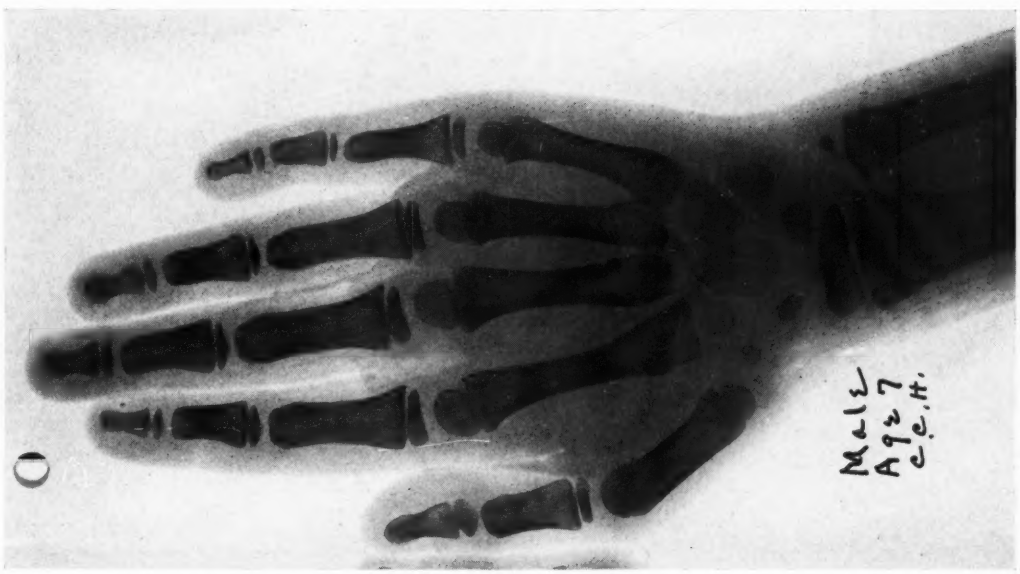


PLATE III.

PLATE IV

ROENTGENOGRAPHIC FINDINGS—AGE EIGHT, MALE

Number of carpals found	2 had 4 2 had 5 4 had 6 41 had 7 1 had 8

The epiphysis of the radius was present in all cases.
Forty-three cases presented an epiphysis of the ulna.
Six cases presented a modified styloid process of the ulna.
Sesamoid bones were absent in all cases.

ROENTGENOGRAPHIC FINDINGS—AGE EIGHT, FEMALE

Number of carpals found	1 had 5 34 had 7 15 had 8

The epiphysis of the radius was present in all cases.
The epiphysis of the ulna was present in all cases.
Nineteen cases presented a modified styloid process of the ulna.
Sesamoid bones were absent in all cases.

PLATE IV.

PLATE V

ROENTGENOGRAPHIC FINDINGS—AGE NINE, MALE

Number of carpals found: 1 had 6; 48 had 7; 1 had 8

The epiphysis of the radius was present in all cases.

Forty-nine cases presented an epiphysis of the ulna.

Nine cases presented a modified styloid process of the ulna.

Sesamoid bones were absent in all cases.

ROENTGENOGRAPHIC FINDINGS—AGE NINE, FEMALE

Number of carpals found: 22 had 7; 28 had 8

The epiphyses of the ulna and radius were present in all cases.

Thirty-three cases presented a modified styloid process of the ulna. Two showed advanced growth of the styloid process.

Eight cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

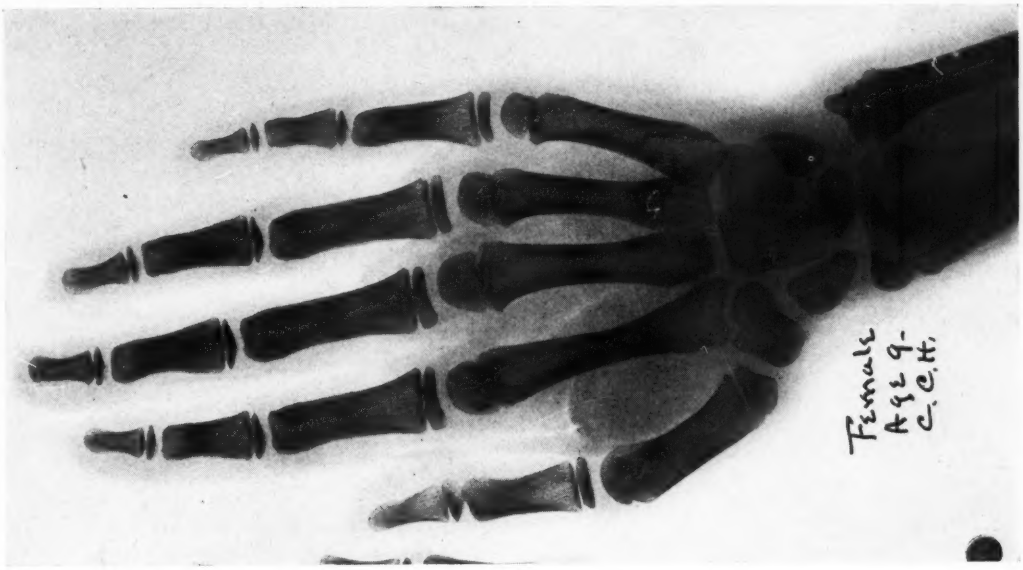


PLATE V.

PLATE VI

ROENTGENOGRAPHIC FINDINGS—AGE TEN, MALE

Number of carpals found

43 had 7

7 had 8

The epiphysis of the radius was present in all cases.

Forty-eight cases presented an epiphysis of the ulna. Twenty-two cases presented a modified styloid process of the ulna. Three showed advanced growth of the styloid process.

Sesamoid bones were absent in all cases.

ROENTGENOGRAPHIC FINDINGS—AGE TEN, FEMALE

Number of carpals found

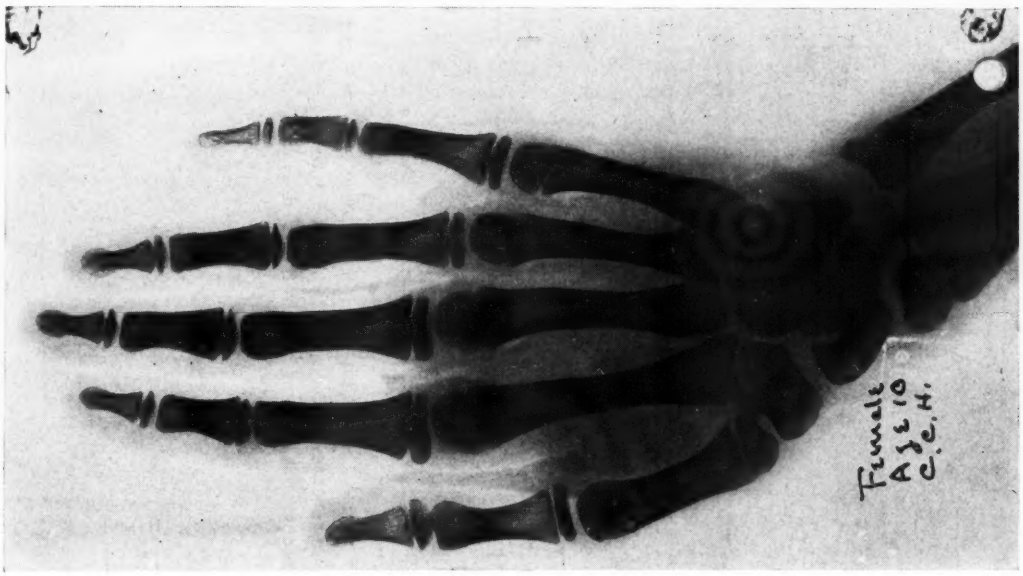
5 had 7

45 had 8

The epiphyses of the ulna and radius were present in all cases.

Eighteen cases presented a modified styloid process of the ulna. Nineteen showed advanced growth of the styloid process.

Eleven cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.



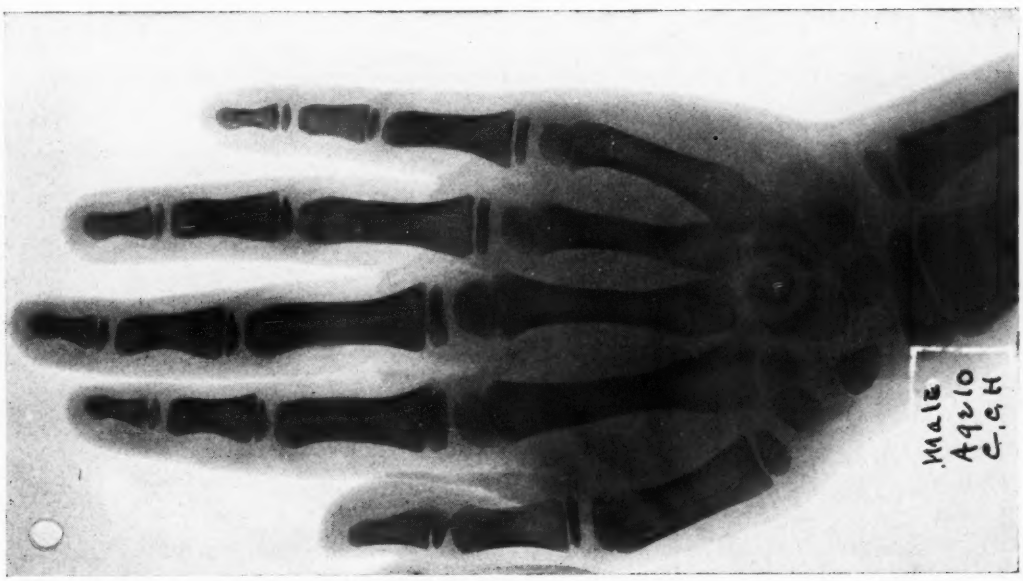


PLATE VI.

PLATE VII

ROENTGENOGRAPHIC FINDINGS—AGE ELEVEN, MALE

Number of carpals found 35 had 7
15 had 8

The epiphyses of the ulna and radius were present in all cases.

Thirty-seven cases presented a modified styloid process of the ulna.

Two cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

ROENTGENOGRAPHIC FINDINGS—AGE ELEVEN, FEMALE

Number of carpals found 50 had 8

The epiphyses of the ulna and radius were present in all cases.

Forty-seven cases presented a modified styloid process of the ulna. Three showed advanced growth of the styloid process.

Forty cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

The literature on the appearance of ossification in the sesamoid bone of the thumb is very scanty or is probably buried under titles relating to other material. It is a significant fact that in this series the normal variation for these bones was not greater than that of other centers of ossification. Note that the female at age eleven presents 80 per cent appearance of this bone.

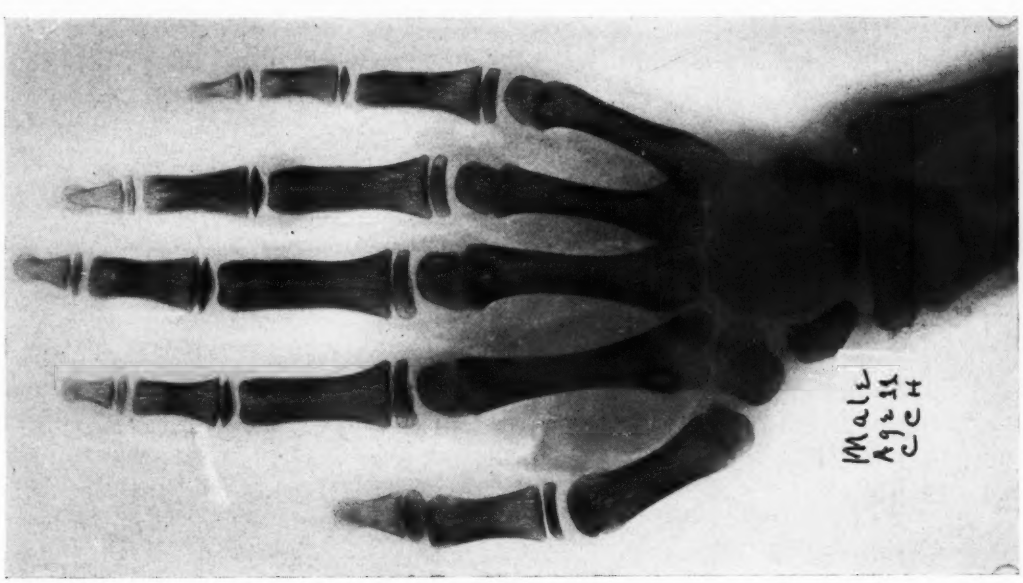


PLATE VII.

PLATE VIII

ROENTGENOGRAPHIC FINDINGS—AGE TWELVE, MALE

Number of carpals found — 7 had 7; 43 had 8

The epiphyses of the ulna and radius were present in all cases.

Forty-five cases presented a modified styloid process of the ulna. Two showed advanced growth of the styloid process.

Nine cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

ROENTGENOGRAPHIC FINDINGS—AGE TWELVE, FEMALE

Number of carpals found — 50 had 8

The epiphyses of the ulna and radius were present in all cases.

Forty cases presented a modified styloid process of the ulna. Ten showed advanced growth of the styloid process.

Forty-six cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

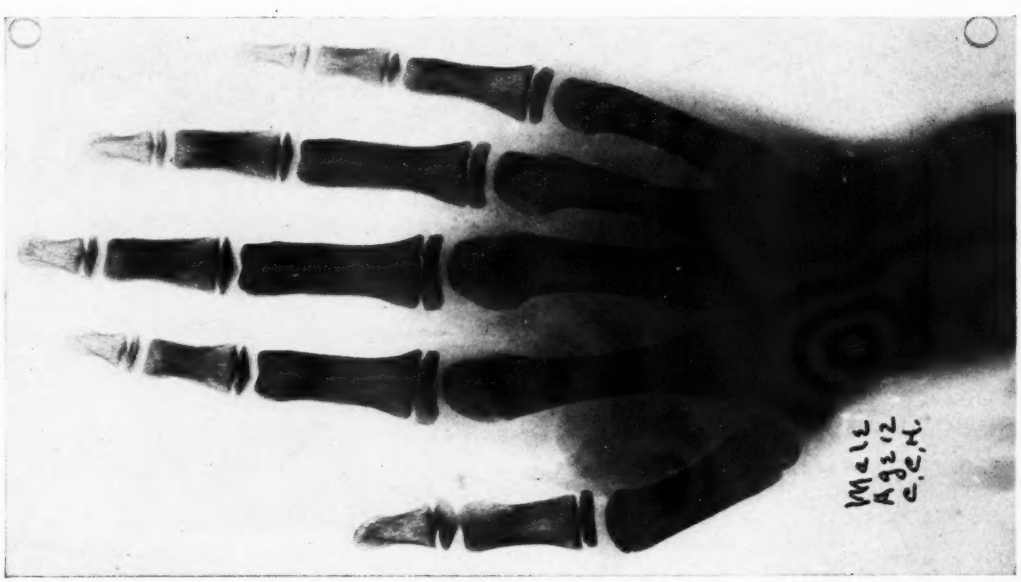


PLATE VIII.

PLATE IX

ROENTGENOGRAPHIC FINDINGS—AGE THIRTEEN, MALE

Number of carpals found 50 had 8

The epiphyses of the ulna and radius were present in all cases.

Forty-five cases presented a modified styloid process of the ulna. Five showed advanced growth of the styloid process.

Twenty cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

ROENTGENOGRAPHIC FINDINGS—AGE THIRTEEN, FEMALE

Number of carpals found 50 had 8

The epiphyses of the ulna and radius were present in all cases.

Sixteen cases presented a modified styloid process of the ulna. Thirty-four showed advanced growth of the styloid process.

Fifty cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

Nine cases showed the union of the epiphyses and the phalanges. All epiphyses of the ulna and radius are yet ununited.

PLATE IX.

PLATE X

ROENTGENOGRAPHIC FINDINGS—AGE FOURTEEN, MALE

Number of carpals found 50

The epiphyses of the ulna and radius were present in all cases.

Twenty-one cases presented a modified styloid process of the ulna. Twenty-seven cases showed advanced growth of the styloid process, and two cases presented no growth of the process.

Thirty-eight cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

The epiphyses of the phalanges were closed in one case.

ROENTGENOGRAPHIC FINDINGS—AGE FOURTEEN, FEMALE

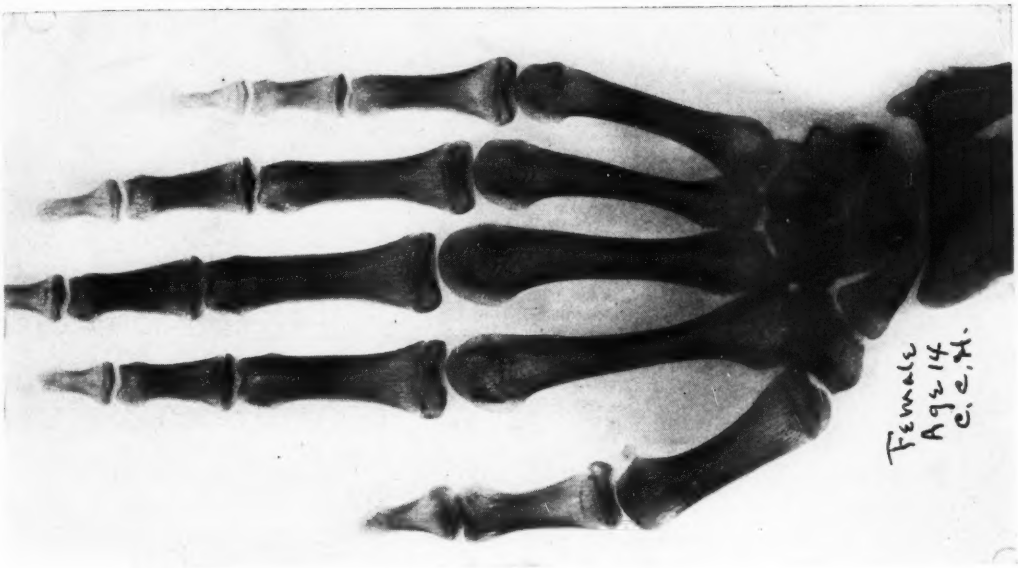
Number of carpals found 50

The epiphyses of the ulna and radius were present in all cases.

One case presented a modified styloid process of the ulna. Forty-nine cases showed advanced growth of the styloid process.

Forty-nine cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

The epiphyses of the phalanges were closed in fifteen cases and two cases showed a closure of the epiphysis of the ulna.



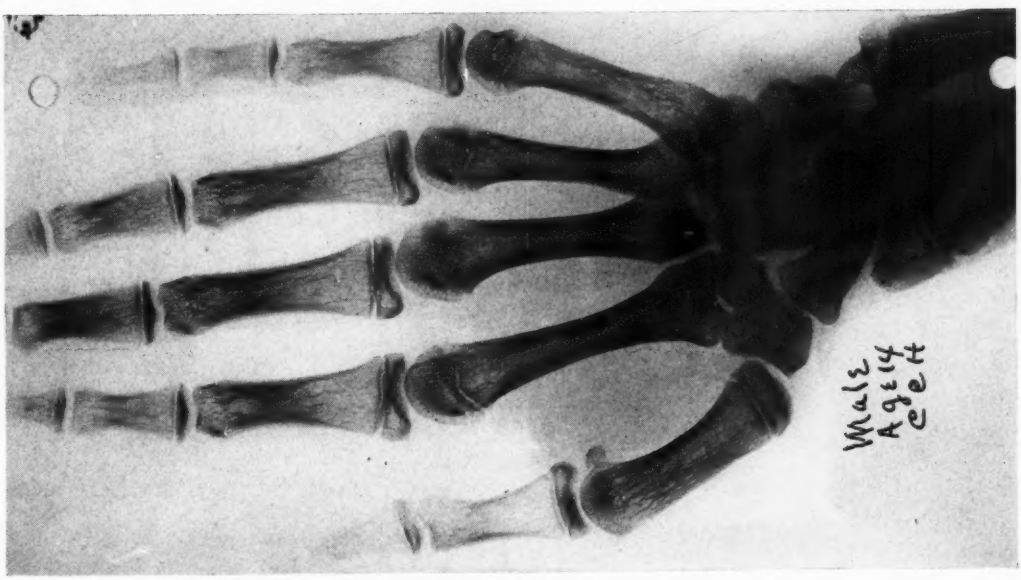


PLATE X.

PLATE XI

ROENTGENOGRAPHIC FINDINGS—AGE FIFTEEN, MALE

Number of carpals found 50

The epiphyses of the ulna and radius were present in all cases.

All fifty cases showed advanced growth of the styloid process of the ulna.

Forty-six cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

The epiphyses had joined the phalanges in two cases. No case showed a union of the epiphyses of the ulna or radius.

ROENTGENOGRAPHIC FINDINGS—AGE FIFTEEN, FEMALE

Number of carpals found 50

The epiphyses of the ulna and radius were present in all cases.

All fifty cases showed advanced growth of the styloid process of the ulna.

All fifty cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

Thirty-seven cases showed the union of the epiphyses of the phalanges. Eight cases showed the union of the epiphysis of the ulna.

The epiphysis of the radius had not closed in any case.

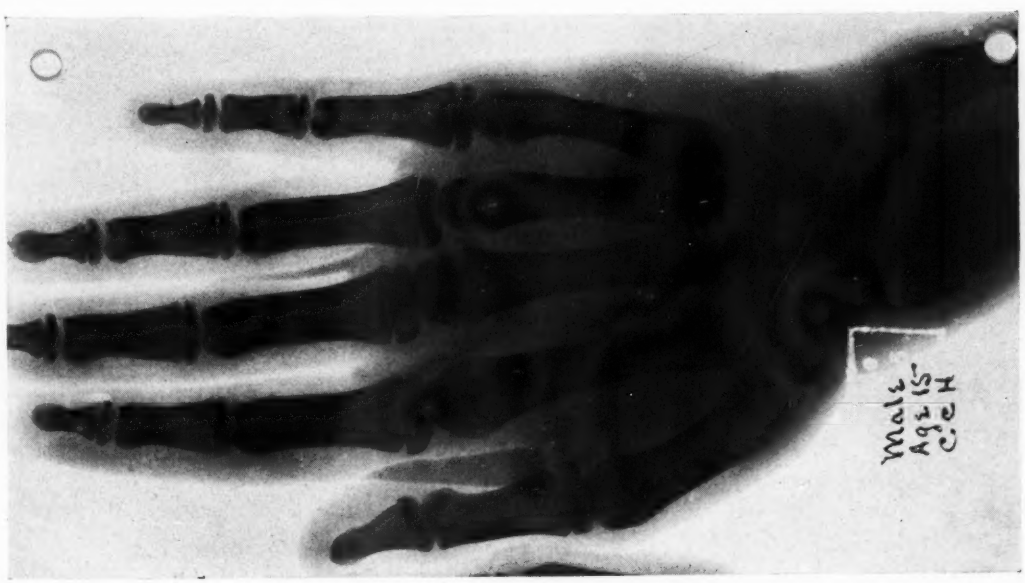


PLATE XI.

PLATE XII

ROENTGENOGRAPHIC FINDINGS—AGE SIXTEEN, MALE

Number of carpals found 50

The epiphyses of the ulna and radius were present in all cases.

Two cases presented a modified styloid process of the ulna. Forty-eight cases showed advanced growth of the styloid process.

All fifty cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

Nine cases showed the union of the epiphyses of the phalanges. Two cases showed the union of the epiphysis of the ulna.

ROENTGENOGRAPHIC FINDINGS—AGE SIXTEEN, FEMALE

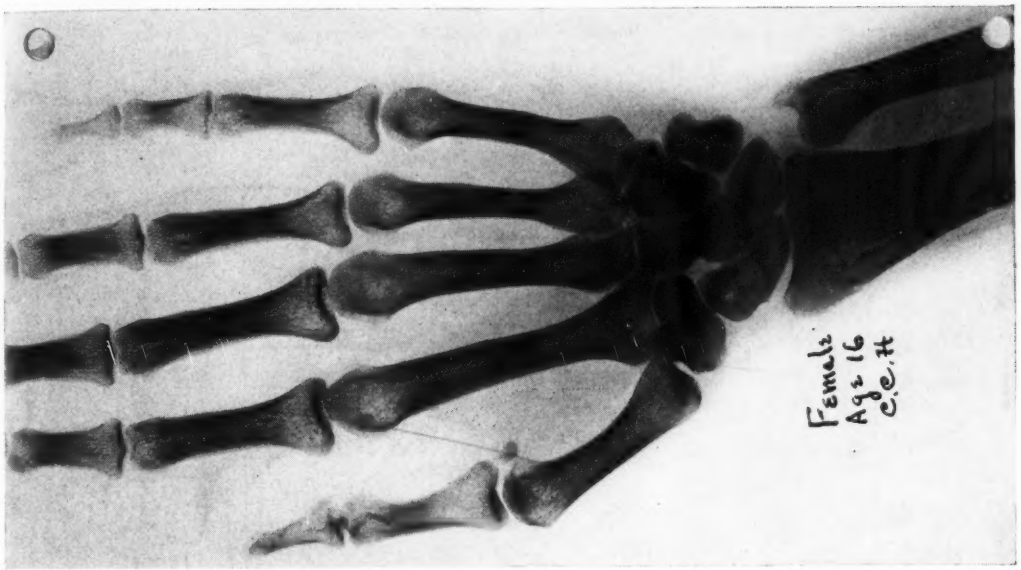
Number of carpals found 50

The epiphyses of the ulna and radius were present in all cases.

All fifty cases showed advanced growth of the styloid process of the ulna.

Forty-nine cases showed the presence of a sesamoid bone at the distal end of the first metacarpal.

Forty-five cases showed the union of the epiphyses of the phalanges, and in twenty-one cases the epiphysis of the ulna had united with its parent bone.



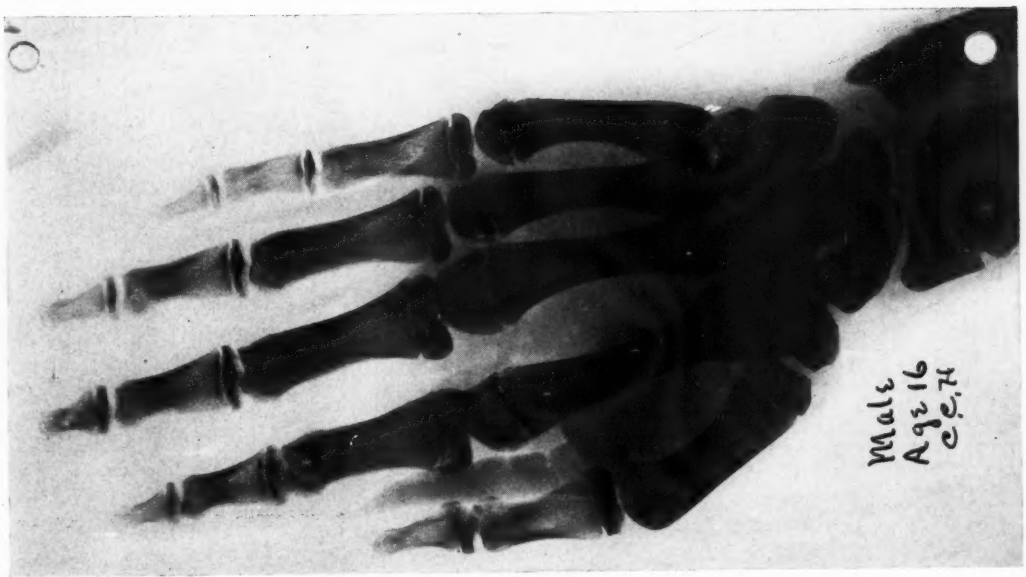


PLATE XII.

AGE FIVE—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
52	5	P	P	A	A	O	O
66	6	P	A	A	A	O	O
68	5	P	A	A	A	O	O
64	7	P	A	A	A	O	O
241	4	P	A	A	A	O	O
240	6	P	A	A	A	O	O
239	4	P	A	A	A	O	O
237	7	P	P	A	A	O	O
238	5	P	A	A	A	O	O
230	7	P	A	A	A	O	O
235	4	P	A	A	A	O	O
236	4	P	A	A	A	O	O
245	5	P	A	A	A	O	O
61	7	P	A	A	A	O	O
62	7	P	P	A	A	O	O
802	5	P	A	A	A	O	O
801	4	P	A	A	A	O	O
800	6	P	A	A	A	O	O
791	4	P	A	A	A	O	O
790	4	P	P	A	A	O	O
789	5	P	A	A	A	O	O
788	6	P	A	A	A	O	O
787	6	P	A	A	A	O	O
786	4	P	A	A	A	O	O
906	6	P	A	A	A	O	O
905	6	P	P	A	A	O	O
819	7	P	A	A	A	O	O
818	4	P	A	A	A	O	O
804	6	P	P	A	A	O	O
803	6	P	A	A	A	O	O
974	4	P	A	A	A	O	O
972	6	P	A	A	A	O	O
973	7	P	A	A	A	O	O
935	7	P	A	A	A	O	O
934	7	P	A	A	A	O	O
914	6	P	A	A	A	O	O
913	6	P	A	A	A	O	O
915	4	P	A	A	A	O	O
927	4	P	A	A	A	O	O
917	4	P	A	A	A	O	O
919	4	P	A	A	A	O	O
918	4	P	A	A	A	O	O
924	4	P	A	A	A	O	O
1432	4	P	A	A	A	O	O
1427	4	P	A	A	A	O	O
1428	5	P	A	A	A	O	O
1429	5	P	A	A	A	O	O
1430	5	P	A	A	A	O	O
1431	4	P	A	A	A	O	O
1439	4	P	A	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE FIVE—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
59	7	P	P	A	A	O	O
60	7	P	A	A	A	O	O
56	7	P	P	A	A	O	O
51	6	P	A	A	A	O	O
50	7	P	P	A	A	O	O
54	5	P	A	A	A	O	O
67	7	P	P	A	A	O	O
243	7	P	P	A	A	O	O
242	7	P	A	A	A	O	O
234	7	P	A	A	A	O	O
231	3(?)	P	A	A	A	O	O
232	7	P	A	A	A	O	O
233	7	P	A	A	A	O	O
244	3	P	A	A	A	O	O
246	7	P	A	A	A	O	O
814	6	P	A	A	A	O	O
813	6	P	A(?)	A	A	O	O
812	7	P	A	A	A	O	O
811	7	P	P	A	A	O	O
809	7	P	P	A	A	O	O
807	7	P	A	A	A	O	O
806	7	P	A	A	A	O	O
796	7	P	P	A	A	O	O
795	7	P	A	A	A	O	O
794	7	P	P	A	A	O	O
792	3	P	A	A	A	O	O
793	5	P	A	A	A	O	O
827	7	P	A	A	A	O	O
829	7	P	A	A	A	O	O
816	7	P	P	A	A	O	O
815	7	P	A	A	A	O	O
817	7	P	P	A	A	O	O
805	6	P	A	A	A	O	O
810	7	P	A	A	A	O	O
808	7	P	A	A	A	O	O
971	7	P	A	A	A	O	O
933	3	P	A	A	A	O	O
932	7	P	A	A	A	O	O
923	7	P	A	A	A	O	O
928	4	P	A	A	A	O	O
916	7	P	A	A	A	O	O
920	7	P	A	A	A	O	O
922	7	P	A	A	A	O	O
929	4	P	A	A	A	O	O
931	7	P	P	A	A	O	O
930	7	P	P	A	A	O	O
926	7	P	A	A	A	O	O
820	7	P	A	A	A	O	O
925	7	P	P	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE SIX—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
305	6	P	A	A	A	O	O
171	7	P	A	A	A	O	O
173	7	P	P	A	A	O	O
170	7	P	P	A	A	O	O
63	7	P	A	A	A	O	O
48	7	P	A	A	A	O	O
47	7	P	P	A	A	O	O
53	7	P	A	A	A	O	O
46	7	P	P	A	A	O	O
4	4	P	P	A	A	O	O
3	5	P	A	A	A	O	O
2	6	P	A	A	A	O	O
1	7	P	A	A	A	O	O
45	4	P	A	A	A	O	O
5	5	P	A	A	A	O	O
37	4	P	A	A	A	O	O
40	7	P	A	A	A	O	O
42	4	P	A(?)	A	A	O	O
39	6	P	A	A	A	O	O
41	4	P	A(?)	A	A	O	O
43	5	P	A	A	A	O	O
38	6	P	A(?)	A	A	O	O
24	6	P	A(?)	A	A	O	O
14	6	P	A	A	A	O	O
16	3	P	A	A	A	O	O
15	7	P	A	A	A	O	O
57	6	P	P	A	A	O	O
23	7	P	P	A	A	O	O
799	4	P	A	A	A	O	O
798	4	P	A	A	A	O	O
797	4	P	A	A	A	O	O
825	3	P	A	A	A	O	O
821	5	P	A	A	A	O	O
822	5	P	A	A	A	O	O
733	5	P	P(?)	A	A	O	O
773	7	P	P	A	A	O	O
772	7	P	A	A	A	O	O
745	5(?)	P	A	A	A	O	O
741	6	P	A	A	A	O	O
738	7	P	P	A	A	O	O
737	3	P	A	A	A	O	O
735	7	P	P	A	A	O	O
695	7	P	P	A	A	O	O
692	7	P	P	A	A	O	O
690	4	P	A	A	A	O	O
689	7	P	A	A	A	O	O
688	6	P	P	A	A	O	O
683	7	P	A(?)	A	A	O	O
676	7	P	A	A	A	O	O
691	7	P	A	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE SIX—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
304	7	P	A	A	A	O	O
268	7	P	A	A	A	O	O
186	7	P	P	A(?)	A	O	O
168	7	P	P	A	A	O	O
156	7	P	P	A(?)	A	O	O
155	7	P	P	A	A	O	O
157	6	P	A	A	A	O	O
11	7	P	P	A	A	O	O
7	7	P	A	A	A	O	O
69	7	P	P	A	A	O	O
65	7	P	P	A	A	O	O
8	7	P	P	A	A	O	O
6	7	P	P	A	A	O	O
10	7	P	P	A	A	O	O
36	6	P	P	A	A	O	O
34	7	P	P	A	A	O	O
55	6	P	A	A	A	O	O
9	7	P	P	A	A	O	O
30	6	P	A	A	A	O	O
31	7	P	P	A	A	O	O
28	7	P	P	A	A	O	O
33	5	P	A	A	A	O	O
29	7	P	A	A	A	O	O
32	6	P	P	A	A	O	O
27	4	P	A	A	A	O	O
26	7	P	P	A	A	O	O
13	7	P	P	A	A	O	O
20	7	P	P	A	A	O	O
21	7	P	P	A	A	O	O
22	7	P	P	A	A	O	O
18	7	P	P	A	A	O	O
19	7	P	P	A	A	O	O
25	7	P	P	A	A	O	O
17	7	P	P	A	A	O	O
12	8	P	P	M	A	O	O
828	7	P	A	A	A	O	O
768	7	P	P	A	A	O	O
769	7	P	P	A	A(?)	O	O
761	7	P	A	A	A	O	O
771	7	P	P	A	A	O	O
770	7	P	P	A	A	O	O
746	7	P	P	A	A	O	O
744	7	P	P	A	A	O	O
739	7	P	A	A	A	O	O
734	7	P	A	A	A	O	O
732	4	P	A	A	A	O	O
684	7	P	P	A	A	O	O
681	7	P	P	A	A	O	O
680	7	P	P	A	A	O	O
678	7	P	P	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE SEVEN—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
297	7	P	P	A	A	O	O
315	7	P	P	A	A	O	O
367	7	P	P	A	A	O	O
204	7	P	P	A	A	O	O
194	6	P	A	A	A	O	O
313	7	P	P	A	A	O	O
364	7	P	P	M	A	O	O
198	7	P	P	A	A	O	O
192	7	P	P	A	A	O	O
190	7	P	P	A	A	O	O
172	7	P	P	A	A	O	O
203	7	P	P	A	A	O	O
200	7	P	P	A	A	O	O
201	7	P	P	A	A	O	O
199	7	P	P	A	A	O	O
166	7	P	A	A	A	O	O
165	5	P	A	A	A	O	O
256	7	P	A	A	A	O	O
195	7	P	P	A	A	O	O
258	7	P	P	A	A	O	O
259	7	P	A	A	A	O	O
255	6	P	A	A	A	O	O
257	7	P	P	A	A	O	O
247	7	P	P	A	A	O	O
250	5	P	P(?)	A	A	O	O
251	7	P	A	A	A	O	O
248	7	P	P	A	A	O	O
252	7	P	P	A	A	O	O
253	7	P	P	A	A	O	O
249	7	P	P	A	A	O	O
274	7	P	P	M	A	O	O
254	7(?)	P	P	A	A	O	O
265	7	P	P	A	A	O	O
275	7	P	P	A	A	O	O
273	7	P	A	A	A	O	O
271	3	P	A	A	A	O	O
272	4	P	P	A	A	O	O
176	6	P	A	A	A	O	O
191	7	P	P	A	A	O	O
169	4	P	A	A	A	O	O
177	7	P	P	A	A	O	O
174	7	P	P	A	A	O	O
44	7	P	P	A	A	O	O
824	4	P	A	A	A	O	O
223	5	P	A	A	A	O	O
723	4	P	A	A	A	O	O
719	7	P	P	A	A	O	O
713	7	P	P	M	A	O	O
705	7	P	P	A	A	O	O
702	7	P	P	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE SEVEN—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
312	7	P	P	M	A	O	O
310	7	P	P	A	A	O	O
308	7	P	P	A	A	O	O
309	8	P	P	A	A	O	O
306	7(?)	P	P	A	A	O	O
332	7	P	P	A	A	O	O
331	7	P	P	A	A	O	O
330	7	P	P	A	A	O	O
307	7(?)	P	P	M	A	O	O
311	7	P	P	A	A	O	O
337	7	P	P	A	A	O	O
365	7	P	P	A	A	O	O
369	7	P	P	A	A	O	O
339	7	P	P	A	A	O	O
161	7	P	P	A	A	O	O
160	7	P	P	A	A	O	O
261	7	P	P	A	A	O	O
263	7	P	P	A	A	O	O
260	7	P	P	A	A	O	O
159	8	P	P	M	A	O	O
262	7	P	P	A	A	O	O
281	8	P	P	M	A	O	O
277	7	P	P	A	A	O	O
276	7	P	P	A	A	O	O
269	7(?)	P	P	A	A	O	O
278	7	P	P	A	A	O	O
266	7	P	P	A	A	O	O
188	7	P	P	A	A	O	O
189	7(?)	P	P	M	A	O	O
154	7	P	P	A	A	O	O
180	7	P	P	A	A	O	O
181	7	P	P	A	A	O	O
179	8	P	P	M	A	O	O
187	7	P	P	A	A	O	O
183	7	P	P	A	A	O	O
185	7	P	A	A	A	O	O
184	7	P	P	M	A	O	O
158	7	P	A	A	A	O	O
35	7	P	P	A	A	O	O
783	7	P	P	A	A	O	O
782	7	P	P	A	A	O	O
781	7	P	P	A	A	O	O
780	7	P	P	A	A	O	O
779	7	P	P	A	A	O	O
729	7	P	A	A	A	O	O
826	7	P	P	A	A	O	O
759	7(?)	P	P	A	A	O	O
725	7	P	A	A	A	O	O
764	7	P	P	A	A	O	O
756	7	P	P	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE EIGHT—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
299	7	P	P	A	A	O	O
293	7	P	P	M	A	O	O
292	7	P	P	A	A	O	O
294	7	P	P	A	A	O	O
290	7	P	P	A	A	O	O
302	7	P	P	A	A	O	O
303	7	P	P	M	A	O	O
413	7	P	P	A	A	O	O
352	5	P	A	A	A	O	O
326	7	P	P	A	A	O	O
319	7	P	P	A	A	O	O
323	7	P	P	A	A	O	O
324	7	P	P	A	A	O	O
325	7	P	A	A	A	O	O
343	6	P	P	A	A	O	O
316	7	P	P	A	A	O	O
320	7	P	P	A	A	O	O
356	7	P	P	A	A	O	O
355	8(?)	P	P	M	A	O	O
291	7	P	P	A	A	O	O
296	7	P	P	M	A	O	O
298	7	P	P	A	A	O	O
162	7	P	P	A	A	O	O
289	6	P	P	A	A	O	O
196	7	P	P	A	A	O	O
197	7	P	P	A	A	O	O
70	7	P	P	A	A	O	O
843	7	P	P	A	A	O	O
839	7	P	P	M	A	O	O
840	7	P	P	A	A	O	O
845	6(?)	P	P	A	A	O	O
846	7	P	P	M	A	O	O
844	7	P	P	A	A	O	O
841	5	P	A	A	A	O	O
842	7	P	P	A	A	O	O
724	7	P	A	A	A	O	O
763	7(?)	P	P	A	A	O	O
667	7	P	P	A	A	O	O
754	7	P	P	A	A	O	O
753	7	P	P	A	A	O	O
752	7	P	P(?)	A	A	O	O
740	4	P	A	A	A	O	O
694	7	P	A	A	A	O	O
672	7	P	P	A	A	O	O
671	7	P	P	A	A	O	O
670	7	P	P	A	A	O	O
669	6	P	A	A	A	O	O
668	7	P	P	A	A	O	O
666	7	P	P	A	A	O	O
665	4	P	P	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE EIGHT—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
334	7	P	P	A	A	O	O
329	7	P	P	A	A	O	O
300	7	P	P	A	A	O	O
301	8	P	P	M	A	O	O
457	7	P	P	A	A	O	O
344	7	P	P	A	A	O	O
358	8	P	P	M	A	O	O
349	8 (?)	P	P	M	A	O	O
463	7	P	P	A	A	O	O
502	8	P	P	M	A	O	O
366	8 (?)	P	P	M	A	O	O
359	7	P	P	A	A	O	O
340	7	P	P	A	A	O	O
341	7	P	P	A	A	O	O
354	8 (?)	P	P	M	A	O	O
361	7	P	P	M	A	O	O
288	7	P	P	A	A	O	O
279	7	P	P	A	A	O	O
280	7 (?)	P	P	M	A	O	O
286	7	P	P	A	A	O	O
285	8	P	P	M	A	O	O
287	7	P	P	A	A	O	O
283	7	P	P	A	A	O	O
284	7	P	P	A	A	O	O
282	7	P	P	A	A	O	O
178	7	P	P	A	A	O	O
76	8	P	P	M	A	O	O
75	7	P	P	M	A	O	O
74	7	P	P	A	A	O	O
73	7	P	P	A	A	O	O
722	7	P	P	A	A	O	O
728	7	P	P	A	A	O	O
716	7	P	P	A	A	O	O
708	7	P	P	A	A	O	O
663	7	P	P	M	A	O	O
661	8 (?)	P	P	M	A	O	O
657	8	P	P	M	A	O	O
656	7	P	P	A	A	O	O
655	7	P	P	A	A	O	O
652	5	P	P	A	A	O	O
651	7	P	P	A	A	O	O
637	7	P	P	A	A	O	O
636	8	P	P	M	A	O	O
635	7	P	P	A	A	O	O
634	7	P	P	A	A	O	O
624	8 (?)	P	P	M	A	O	O
706	8	P	P	M	A	O	O
270	8	P	P	M	A	O	O
264	7	P	P	A	A	O	O
336	8	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE NINE—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
442	7	P	P	A	A	O	O
446	7	P	P	A	A	O	O
441	7	P	P	A	A	O	O
347	7	P	P	A	A	O	O
351	7	P	P	A	A	O	O
317	7	P	P	A	A	O	O
321	7	P	P	A	A	O	O
462	7	P	P	A	A	O	O
451	7	P	P	A	A	O	O
480	7	P	P	A	A	O	O
478	7	P	P	A	A	O	O
474	7	P	P	M	A	O	O
461	7	P	P	A	A	O	O
506	7	P	P	M	A	O	O
500	7	P	P	A	A	O	O
481	7	P	P	A	A	O	O
468	6	P	P	A	A	O	O
494	7	P	P	A	A	O	O
493	7 (?)	P	P	M	A	O	O
496	7	P	P	A	A	O	O
499	7	P	P	A	A	O	O
498	7 (?)	P	P	M	A	O	O
489	7	P	P	M	A	O	O
460	7	P	P	M	A	O	O
447	7	P	P	A	A	O	O
450	7	P	P	A	A	O	O
449	7	P	A	A	A	O	O
448	7	P	P	A	A	O	O
202	7	P	P	A	A	O	O
353	7	P	P	A	A	O	O
123	7	P	P	M	A	O	O
130	7	P	P	A	A	O	O
121	7	P	P	A	A	O	O
100	7	P	P	A	A	O	O
101	7	P	P	A	A	O	O
94	7	P	P	A	A	O	O
92	7	P	P	A	A	O	O
620	7	P	P	A	A	O	O
602	7	P	P	M	A	O	O
599	7	P	P	A	A	O	O
600	7	P	P	A	A	O	O
601	7	P	P	M	A	O	O
603	7	P	P	A	A	O	O
458	7	P	P	A	A	O	O
454	7	P	P	A	A	O	O
440	7 (?)	P	P	A	A	O	O
495	7	P	P	A	A	O	O
467	7	P	P	A	A	O	O
466	8	P	P	A	A	O	O
95	7	P	P	A	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE NINE—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
453	7	P	P	M	A	O	O
411	8	P	P	M	A	O	O
403	8	P	P	M	A	O	O
402	7	P	P	M	A	O	O
328	8	P	P	Ad–	P	O	O
437	8 (?)	P	P	M	A	O	O
456	7 (?)	P	P	A	A	O	O
434	7 (?)	P	P	A	A	O	O
432	7	P	P	M	A	O	O
507	8	P	P	M	A	O	O
464	8	P	P	M	A	O	O
471	7 (?)	P	P	A	A	O	O
504	7	P	P	A	A	O	O
505	7	P	P	A	A	O	O
490	8	P	P	M	P	O	O
487	8 (?)	P	P	M	P	O	O
486	7	P	P	A	A	O	O
433	8	P	P	M	A	O	O
435	8	P	P	M	A	O	O
428	8	P	P	A	A	O	O
425	8	P	P	M	A	O	O
436	8	P	P	M	A	O	O
426	7	P	P	A	A	O	O
429	8	P	P	M	P	O	O
430	8	P	P	M	A	O	O
373	8	P	P	M	P	O	O
398	8	P	P	M	A	O	O
89	8	P	P	Ad–	A	O	O
110	7 (?)	P	P	M	A	O	O
80	8 (?)	P	P	M	A	O	O
77	8	P	P	M	A	O	O
78	8	P	P	M	P	O	O
662	8	P	P	M	P	O	O
659	8	P	P	M	A	O	O
654	7	P	P	A	A	O	O
653	7	P	P	A	A	O	O
650	7 (?)	P	P	A	A	O	O
649	7	P	P	M	A	O	O
648	8	P	P	M	A	O	O
647	8	P	P	A	A	O	O
645	7 (?)	P	P	M	A	O	O
644	8	P	P	M	A	O	O
643	7 (?)	P	P	M	A	O	O
642	8	P	P	M	A	O	O
640	7	P	P	M	A	O	O
639	7	P	P	A	A	O	O
638	7 (?)	P	P	A	A	O	O
623	7	P	P	A	A	O	O
619	8	P	P	M	P (?)	O	O
609	7	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE TEN—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
99	7	P	P	A	A	O	O
91	7	P	P	A	A	O	O
102	7	P	P	M	A	O	O
103	7	P	P	M	A	O	O
119	7	P	P	M	A	O	O
136	7	P	P	M	A	O	O
131	7	P	P	A	A	O	O
362	7	P	P	M	A	O	O
363	7	P	P	M	A	O	O
342	7	P	P	M	A	O	O
392	7	P	P	M	A	O	O
491	8	P	P	M	A	O	O
469	7	P	P	A	A	O	O
475	7	P	P	M	A	O	O
470	7 (?)	P	P	M	A	O	O
459	7	P	P	A	A	O	O
346	7	P	P	M	A	O	O
445	7	P	P	A	A	O	O
419	7 (?)	P	P	A	A	O	O
414	7	P	P	M	A	O	O
417	7	P	P	M	A	O	O
418	7	P	P	M	A	O	O
415	7 (?)	P	P	M	A	O	O
416	8	P	P	Ad	P	O	O
439	7	P	P	A	A	O	O
327	7 (?)	P	P	M	A	O	O
391	7	P	P	A	A	O	O
614	7	P	A	A	A	O	O
594	7	P	P	A	A	O	O
593	7	P	A	A	A	O	O
591	8	P	P	A	A	O	O
590	7	P	P	A	A	O	O
589	7	P	P	M	A	O	O
588	8	P	P	M	A	O	O
587	8	P	P	Ad–	A	O	O
574	7 (?)	P	P	A	A	O	O
573	7	P	P	A	A	O	O
571	7	P	P	A	A	O	O
569	7	P	P	A	A	O	O
552	8	P	P	M	A	O	O
476	7	P	P	M	A	O	O
477	7	P	P	M	A	O	O
424	8	P	P	Ad	A	O	O
125	7	P	P	A	A	O	O
126	7	P	P	A	A	O	O
96	7	P	P	A	A	O	O
90	7	P	P	A	A	O	O
1436	7	P	P	A	A	O	O
1438	7	P	P	A	A	O	O
622	7	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE TEN—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
81	8	P	P	Ad	A	O	O
79	8	P	P	Ad	A	O	O
109	8	P	P	M	A	O	O
86	8	P	P	M	A	O	O
117	8	P	P	Ad	P	O	O
114	8	P	P	Ad	P	O	O
113	8 (?)	P	P	M	A	O	O
112	8	P	P	M	A	O	O
107	8	P	P	M	A	O	O
104	8	P	P	M	A	O	O
108	7	P	P	A	A	O	O
226	8	P	P	A	A	O	O
216	8	P	P	Ad	P	O	O
360	8	P	P	Ad–	P	O	O
378	8	P	P	Ad	P	O	O
397	8	P	P	Ad	A	O	O
497	8	P	P	Ad	P	O	O
503	7	P	P	A	A	O	O
455	7	P	P	A	A	O	O
407	8	P	P	Ad	P	O	O
400	8	P	P	M	A	O	O
410	8	P	P	M	A	O	O
405	8 (?)	P	P	M	A	O	O
408	8	P	P	Ad	A	O	O
836	8	P	P	Ad	P	O	O
837	8	P	P	A	A	O	O
834	8	P	P	Ad	P	O	O
832	8 (?)	P	P	M	A	O	O
833	8	P	P	Ad	A	O	O
835	8 (?)	P	P	Ad	A	O	O
838	7	P	P	A	A	O	O
660	8	P	P	M	A	O	O
658	8	P	P	A	A	O	O
631	8	P	P	Ad	P	O	O
630	8	P	P	M	A	O	O
629	8	P	P	M	A	O	O
628	8	P	P	Ad	A	O	O
627	7 (?)	P	P	M	A	O	O
626	8	P	P	Ad	A	O	O
584	8	P	P	A	A	O	O
583	8 (?)	P	P	A	A	O	O
582	8	P	P	A	A	O	O
581	8	P	P	M	A	O	O
579	8	P	P	A	A	O	O
578	8	P	P	A	A	O	O
611	8	P	P	Ad–	P	O	O
567	8	P	P	M	A	O	O
564	8 (?)	P	P	A	A	O	O
563	8 (?)	P	P	M	A	O	O
561	8	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE ELEVEN—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
452	8	P	P	M	A	O	O
438	7	P	P	A	A	O	O
422	7	P	P	A	A	O	O
421	7	P	P	A	A	O	O
488	7	P	P	A	A	O	O
390	7	P	P	M	A	O	O
395	7	P	P	A	A	O	O
387	7	P	P	A	A	O	O
393	8	P	P	M	A	O	O
394	7	P	P	A	A	O	O
124	7	P	P	M	A	O	O
215	7	P	P	A	A	O	O
214	8	P	P	M	A	O	O
122	7	P	P	A	A	O	O
134	7	P	P	A	A	O	O
145	7 (?)	P	P	M	A	O	O
127	8	P	P	M	P	O	O
206	7	P	P	M	A	O	O
137	8 (?)	P	P	M	A	O	O
140	7	P	P	M	A	O	O
138	8	P	P	M	A	O	O
132	7 (?)	P	P	M	A	O	O
139	8	P	P	M	A	O	O
97	7	P	P	M	A	O	O
864	7	P	P	M	A	O	O
863	8	P	P	M	A	O	O
613	7 (?)	P	P	M	A	O	O
849	7	P	P	A	A	O	O
851	8 (?)	P	P	M	A	O	O
850	8	P	P	M	A	O	O
865	8 (?)	P	P	M	A	O	O
816	7	P	P	M	A	O	O
815	7	P	P	A	A	O	O
598	7	P	P	M	A	O	O
595	8	P	P	M	A	O	O
592	7	P	P	A	A	O	O
572	8	P	P	M	A	O	O
570	7	P	P	M	A	O	O
562	7	P	P	M	A	O	O
544	7	P	P	M	A	O	O
542	7	P	P	M	A	O	O
541	7	P	P	M	A	O	O
539	7	P	P	M	A	O	O
525	8 (?)	P	P	M	A	O	O
524	7	P	P	M	A	O	O
515	7	P	P	M	A	O	O
514	8	P	P	M	P	O	O
509	7 (?)	P	P	M	A	O	O
510	7	P	P	M	A	O	O
508	7	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE ELEVEN—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
375	8	P	P	M	A	O	O
374	8	P	P	M	P	O	O
376	8	P	P	M	P	O	O
483	8	P	P	M	A	O	O
431	8	P	P	M	P	O	O
371	8	P	P	M	A	O	O
380	8	P	P	M	P	O	O
379	8	P	P	M	P	O	O
217	8	P	P	M	P	O	U
220	8	P	P	M	P	O	O
224	8	P	P	M	P	O	O
229	8	P	P	M	A	O	O
222	8	P	P	Ad	P	O(?)	O
227	8	P	P	Ad	P	O	O
141	8(?)	P	P	M	P	O	O
133	8	P	P	M	A	O	O
143	8	P	P	M	P	O	O
148	8	P	P	Ad	P	O	O
142	8	P	P	M	P	O	O
106	8	P	P	M	P	O	O
862	8	P	P	M	P	O	O
861	8	P	P	M	P	O	O
860	8	P	P	M	A	O	O
859	8	P	P	M	P	O	O
858	8	P	P	M	P	O	O
857	8	P	P	M	P	O	O
856	8	P	P	M	P	O	O
855	8	P	P	M	P	O	O
854	8	P	P	M	P	O	O
853	8(?)	P	P	M	P	O	O
847	8	P	P	M	P(?)	O	O
848	8	P	P	M	P	O	O
641	8	P	P	M	P	O	O
632	8	P	P	M	A	O	O
580	8	P	P	M	P	O(?)	O
566	8	P	P	M	P	O	O
565	8	P	P	A	A	O	O
559	8	P	P	M	A	O	O
557	8	P	P	M	A	O	O
556	8	P	P	M	P	O	O
554	8	P	P	M	P	O	O
531	8	P	P	M	P(?)	O	O
530	8	P	P	M	P	O	O
513	8	P	P	M	P	O	O
512	8	P	P	M	P	O	O
511	8	P	P	M	P	O	O
830	8	P	P	M	A	O	O
940	8	P	P	M	P	O	O
941	8	P	P	M	P(?)	O	O
942	8	P	P	M	P	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE TWELVE—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
389	8(?)	P	P	M	A	O	O
479	8	P	P	M	A	O	O
386	8	P	P	M	A	O	O
388	8	P	P	M	A	O	O
208	8	P	P	M	A	O	O
211	8	P	P	M	A	O	O
153	8	P	P	M	A	O	O
93	8	P	P	M	A	O	O
98	8	P	P	M	A	O	O
881	8	P	P	Ad–	P	O	O
882	8(?)	P	P	M	A	O	O
883	7(?)	P	P	M	A	O	O
868	8(?)	P	P	A	A	O	O
867	8	P	P	M	A	O	O
869	8	P	P	M	A	O	O
895	8(?)	P	P	M	A	O	O
892	8	P	P	M	P	O	O
890	7(?)	P	P	A	A	O	O
891	7	P	P	M	A	O	O
894	8	P	P	M	A	O	O
893	8	P	P	M	A	O	O
889	7	P	P	M	A	O	O
884	8	P	P	M	A	O	O
886	8	P	P	M	P	O	O
887	8	P	P	M	A	O	O
885	8	P	P	M	A	O	O
618	8	P	P	M	A	O	O
597	7(?)	P	P	M	A	O	O
576	8	P	P	M	P	O	O
553	7(?)	P	P	A	A	O	O
549	8	P	P	M	A	O	O
547	8	P	P	M	A	O	O
546	8	P	P	M	P	O	O
545	8	P	P	M	A	O	O
543	8	P	P	M	A	O	O
540	7	P	P	M	A	O	O
538	8(?)	P	P	M	A	O	O
529	8	P	P	M	A	O	O
518	8	P	P	M	P	O	O
517	8	P	P	M	A	O	O
516	8	P	P	M	A	O	O
969	8	P	P	M	A	O	O
961	8	P	P	M	A	O	O
953	8(?)	P	P	M	A	O	O
955	8	P	P	M	A	O	O
956	8	P	P	M	P	O	O
557	8	P	P	M	A	O	O
954	8	P	P	M	P	O	O
936	8	P	P	Ad	P	O	O
946	8	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE TWELVE—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
228	8	P	P	M	P	O	O
151	8	P	P	M	P	O	O
872	8	P	P	M	P	O	O
904	8	P	P	M	P	O	O
902	8	P	P	M	P	O	O
903	8	P	P	M	P	O	O
901	8	P	P	Ad–	P	O	O
900	8	P	P	M	P	O	O
877	8	P	P	M	P	O	O
879	8	P	P	M	P	O	O
880	8	P	P	M	P	O	O
873	8	P	P	M	P	O	O
874	8	P	P	M	P	O	O
876	8	P	P	M	P	O	O
871	8	P	P	Ad	P	O	O
878	8	P	P	Ad	P	O	O
870	8	P	P	M	P	O	O
896	8	P	P	M	P	O	O
898	8	P	P	M	P	O	O
897	8	P	P	M	P	O	O
899	8	P	P	M	P	O	O
610	8	P	P	M	A	O	O
568	8	P	P	M	P	O	O
535	8	P	P	M	P	O	O
534	8	P	P	M	A	O	O
533	8	P	P	M	P	O	O
532	8	P	P	M	P	O	O
950	8	P	P	M	A	O	O
952	8	P	P	Ad	P	O	O
947	8	P	P	M	P	O	O
962	8	P	P	Ad–	P	O	O
944	8	P	P	Ad–	P	O	O
949	8	P	P	Ad–	P	O	O
945	8	P	P	M	P	O	O
948	8	P	P	M	P	O	O
938	8	P	P	M	P	O	O
1207	8	P	P	M	P	O	O
1198	8	P	P	M	P	O	O
1199	8	P	P	M	P	O	O
1150	8	P	P	M	P	O	O
1156	8	P	P	M	P	O	O
1187	8	P	P	M	P	O	O
1136	8	P	P	M	P	O	O
1135	8	P	P	M	P	O	O
1107	8	P	P	M	A	O	O
1092	8	P	P	M	P	O	O
1033	8	P	P	Ad	P	O	O
1025	8	P	P	M	P	O	O
1018	8	P	P	Ad–	P	O	O
1019	8	P	P	Ad	P	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE THIRTEEN—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1210	8	P	P	Ad	P	O	O
1190	8	P	P	M	A	O	O
1193	8	P	P	M	A	O	O
1194	8	P	P	M	P	O	O
1155	8	P	P	M	A	O	O
1165	8	P	P	M	A	O	O
1192	8	P	P	Ad–	P	O	O
1130	8	P	P	Ad	P	O	O
1132	8	P	P	M	A	O	O
1099	8	P	P	M	A	O	O
1084	8	P	P	M	P	O	O
1032	8	P	P	M	P	O	O
1053	8	P	P	M	A	O	O
1042	8	P	P	M	P	O	O
1060	8	P	P	M	A	O	O
1044	8	P	P	M	A	O	O
1048	8	P	P	Ad	P	O	O
1026	8	P	P	M	A	O	O
968	8	P	P	Ad	P	O	O
967	8	P	P	M	P	O	O
966	8	P	P	M	P	O	O
980	8	P	P	M	A	O	O
979	8	P	P	M	A(?)	O	O
986	8	P	P	M	A	O	O
982	8	P	P	M	A	O	O
912	8	P	P	M	A	O	O
910	8	P	P	M	A	O	O
908	8	P	P	M	P	O	O
958	7(?)	P	P	M	A	O	O
966	8(?)	P	P	M	A	O	O
586	8	P	P	M	P	O	O
575	8	P	P	M	A(?)	O	O
528	8	P	P	M	P	O	O
520	8	P	P	M	P	O	O
519	8	P	P	M	P	O	O
205	8	P	P	M	P	O	O
210	8	P	P	M	A	O	O
1281	8	P	P	M	P	O	O
1268	8(?)	P	P	M	A	O	O
1266	8	P	P	M	A	O	O
1261	8	P	P	M	A	O	O
1233	8	P	P	M	A	O	O
1238	8	P	P	M	A	O	O
1244	8	P	P	M	A	O	O
1232	8	P	P	M	A	O	O
1227	8	P	P	M	P	O	O
1257	8	P	P	M	A	O	O
1249	8	P	P	M	P	O	O
1230	8	P	P	M	A	O	O
1234	8	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE THIRTEEN—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1213	8	P	P	Ad	P	O	O
1202	8	P	P	M	P	O	O
1201	8	P	P	Ad	P	O	O
1214	8	P	P	Ad	P	C	O
1215	8	P	P	M	P	O	O
1219	8	P	P	M	P	O	O
1212	8	P	P	M	P	O	O
1189	8	P	P	M	P	O	O
1182	8	P	P	M	P	O	O
1160	8	P	P	Ad	P	O	O
1197	8	P	P	Ad	P	O	O
1177	8	P	P	M	P	O	O
1180	8	P	P	Ad	P	C	O
1149	8	P	P	M	P	O	O
1153	8	P	P	Ad	P	O	O
1145	8	P	P	Ad	P	O	O
1167	8	P	P	Ad	P	O	O
1158	8	P	P	Ad	P	C	O
1154	8	P	P	Ad	P	O	O
1147	8	P	P	Ad	P	O	O
1144	8	P	P	Ad	P	C	O
1143	8	P	P	Ad	P	O	O
1186	8	P	P	M	P	O	O
1188	8	P	P	Ad	P	C	O
1125	8	P	P	Ad	P	O	O
1138	8	P	P	Ad	P	O	O
1140	8	P	P	Ad	P	C	O
1123	8	P	P	Ad	P	O	O
1100	8	P	P	Ad	P	O	O
1095	8	P	P	M	P	O	O
1096	8	P	P	M	P	O	O
1098	8	P	P	Ad	P	O	O
1094	8	P	P	Ad	P	O	O
1090	8	P	P	M	P	O	O
1089	8	P	P	Ad	P	O	O
1097	8	P	P	Ad	P	C	O
1031	8	P	P	Ad	P	O	O
1021	8	P	P	Ad	P	O	O
1023	8	P	P	M	P	O	O
1009	8	P	P	M	P	O	O
1017	8	P	P	M	P	O	O
1002	8	P	P	Ad	P	O	O
1003	8	P	P	Ad	P	O	O
963	8	P	P	Ad	P	C	O
951	8	P	P	Ad	P	O	O
612	8	P	P	Ad	P	C	O
523	8	P	P	M	P	O	O
522	8	P	P	Ad	P	O	O
521	8	P	P	Ad	P	O	O
221	8	P	P	Ad	P	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE FOURTEEN—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1164	8	P	P	M	A	O	O
1166	8	P	P	M	P	O	O
1185	8	P	P	Ad	P	O	O
1129	8(?)	P	P	M	A	O	O
1083	8	P	P	A	A	O	O
1030	8	P	P	Ad	P	O	O
1054	8	P	P	Ad	P	O	O
1057	8	P	P	A	A	O	O
1056	8	P	P	Ad	P	O	O
1058	8	P	P	Ad	P	O	O
1028	8	P	P	M	P	O	O
1050	8	P	P	Ad	P	O	O
1051	8	P	P	M	P	O	O
1052	8	P	P	M	P	O	O
1045	8	P	P	M	A	O	O
1047	8	P	P	Ad	P	O	O
1046	8	P	P	Ad	P	O	O
1022	8	P	P	M	P	O	O
1035	8	P	P	Ad	P	O	O
1036	8	P	P	M	P	O	O
989	8	P	P	Ad	P	O	O
977	8	P	P	Ad	P	O	O
981	8	P	P	Ad	A	O	O
987	8	P	P	Ad	P	O	O
991	8	P	P	Ad	P	O	O
983	8	P	P	M	P	O	O
984	8	P	P	Ad	P	O	O
985	8	P	P	Ad	P	O	O
911	8(?)	P	P	M	P	O	O
596	8	P	P	Ad	A	O	O
548	8	P	P	Ad	P	O	O
527	8	P	P	Ad	P	O	O
526	8	P	P	Ad	P	O	O
1280	8	P	P	Ad	P	O	O
1279	8	P	P	M	A	O	O
1272	7(?)	P	P	A	A	O	O
1243	8	P	P	M	A	O	O
1242	8	P	P	M	P	O	O
1226	8	P	P	M	P	O	O
1240	8	P	P	M	A	O	O
1256	8	P	P	M	A	O	O
1235	8	P	P	Ad	P	C	O
1231	8	P	P	Ad	P	O	O
1237	8(?)	P	P	M	A	O	O
1229	8	P	P	Ad	P	O	O
1061	8	P	P	Ad	P	O	O
1335	8	P	P	Ad	P	O	O
1435	8	P	P	M	A	O	O
1434	8	P	P	M	P	O	O
1433	8(?)	P	P	M	A	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE FOURTEEN—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF ULNA PRESENT	EPIPHYSIS OF RADIUS PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1204	8	P	P	Ad	P	C	O
1203	8	P	P	Ad	P	O	O
1206	8	P	P	Ad	P	C	O
1221	8	P	P	Ad	P	C	O
1196	8	P	P	Ad	P	C(?)	C(?)
1176	8	P	P	Ad	P	C	C
1172	8	P	P	Ad	P	O	O
1174	8	P	P	Ad	P	O	O
1179	8	P	P	Ad	P	C	O
1178	8	P	P	Ad	P	O	O
1168	8	P	P	Ad	P	O	O
1152	8	P	P	Ad	P	O	O
1146	8	P	P	Ad	P	O	O
1148	8	P	P	Ad	P	C	O
1157	8	P	P	Ad	P	O	O
1159	8	P	P	Ad	P	O	O
1128	8	P	P	Ad	P	O	O
1139	8	P	P	Ad	P	O	O
1137	8	P	P	Ad	P	C(?)	O
1102	8	P	P	Ad	P	O	O
1104	8	P	P	Ad	P	O	O
1093	8	P	P	Ad	P	O	O
1091	8	P	P	Ad	P	O	O
1067	8	P	P	Ad	P	O	O
1065	8	P	P	Ad	P	O	O
1029	8	P	P	Ad	P	O	O
1014	8	P	P	Ad	P	C(?)	O
1008	8	P	P	Ad	P	C	O
1010	8	P	P	Ad	P	O	O
1007	8	P	P	Ad	P	O	O
1015	8	P	P	Ad	P	O	O
1004	8	P	P	Ad	P	C(?)	O
997	8	P	P	Ad	P	C	O(?)
999	8	P	P	Ad	P	C(?)	O(?)
907	8	P	P	M	A	O	O
909	8	P	P	Ad	P	O	O
537	8	P	P	Ad	P	O	O
536	8	P	P	Ad	P	O	O
1277	8	P	P	Ad	P	O	O
1275	8	P	P	Ad	P	O	O
1270	8	P	P	Ad	P	C(?)	O
1262	8	P	P	Ad	P	O	O
1252	8	P	P	Ad	P	O	O
1245	8	P	P	Ad	P	O	O
1246	8	P	P	Ad	P	O	O
1259	8	P	P	Ad	P	C(?)	O
1251	8	P	P	Ad	P	O	O
1248	8	P	P	Ad	P	O	O
1124	8	P	P	Ad	P	O	O
1078	8	P	P	Ad	P	C	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE FIFTEEN—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1220	8	P	P	Ad	P	O	O
1195	8	P	P	Ad	P	O	O
1282	8	P	P	Ad	P	O	O
1038	8	P	P	Ad	P	O	O
1024	8	P	P	Ad	P	O	O
1034	8	P	P	Ad	P	O	O
1055	8	P	P	Ad	P	O	O
1039	8	P	P	Ad	P	O	O
1040	8	P	P	Ad	P	O	O
1059	8	P	P	Ad	P	O	O
1043	8	P	P	Ad	A	O	O
975	8	P	P	Ad	P	O	O
978	8	P	P	Ad	A	O	O
976	8	P	P	Ad	P	O	O
988	8	P	P	Ad	P	O	O
990	8	P	P	Ad	P	C(?)	O
995	8	P	P	Ad	P	O	O
996	8	P	P	Ad	P	O	O
551	8	P	P	Ad	P	O	O
550	8	P	P	Ad	P	O	O
1239	8	P	P	Ad	P	O	O
1228	8	P	P	Ad	P	O	O
1241	8	P	P	Ad	P	O	O
1258	8	P	P	Ad	P	O	O
1255	8	P	P	Ad	A	O	O
1223	8	P	P	Ad	P	O	O
1082	8	P	P	Ad	P	O	O
1286	8	P	P	Ad	P	O	O
1368	8	P	P	Ad	P	O	O
1312	8	P	P	Ad	P	O	O
1310	8	P	P	Ad	P	O	O
1309	8	P	P	Ad	P	O	O
1308	8	P	P	Ad	P	O	O
1307	8	P	P	Ad	P	O	O
1306	8	P	P	Ad	P	O	O
1305	8	P	P	Ad	P	O	O
1304	8	P	P	Ad	P	O	O
1303	8	P	P	Ad	P	O	O
1302	8	P	P	Ad	P	O	O
1301	8	P	P	Ad	P	O	O
1300	8	P	P	Ad	P	O	O
1297	8	P	P	Ad	P	O	O
1295	8	P	P	Ad	P	O	O
1293	8	P	P	Ad	P	O	O
1292	8	P	P	Ad	P	O	O
1291	8	P	P	Ad	A	O	O
1290	8	P	P	Ad	P	O	O
1289	8	P	P	Ad	P	O	O
1288	8	P	P	Ad	P	O	O
1287	8	P	P	Ad	P	C(?)	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE FIFTEEN—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1424	8	P	P	Ad	P	C	O
1422	8	P	P	Ad	P	C	O
1421	8	P	P	Ad	P	C	O
1334	8	P	P	Ad	P	C	C-U
1332	8	P	P	Ad	P	C	O
1331	8	P	P	Ad	P	C	O
1330	8	P	P	Ad	P	C	C-U
1329	8	P	P	Ad	P	C	O
1328	8	P	P	Ad	P	C	O
1327	8	P	P	Ad	P	C	O
1326	8	P	P	Ad	P	O	O
1325	8	P	P	Ad	P	O	O
1324	8	P	P	Ad	P	C	O
1323	8	P	P	Ad	P	O	O
1322	8	P	P	Ad	P	O	O
1321	8	P	P	Ad	P	C	O
1320	8	P	P	Ad	P	C	O
1319	8	P	P	Ad	P	C	O
1318	8	P	P	Ad	P	C	O
1317	8	P	P	Ad	P	C	C-U
1316	8	P	P	Ad	P	C	O
1315	8	P	P	Ad	P	C	C-U
1314	8	P	P	Ad	P	C	C-U
1313	8	P	P	Ad	P	O	O
1299	8	P	P	Ad	P	C	C-U
1408	8	P	P	Ad	P	C	O
1068	8	P	P	Ad	P	O	O
1217	8	P	P	Ad	P	O	O
1216	8	P	P	Ad	P	C	O
1218	8	P	P	Ad	P	O	O
1209	8	P	P	Ad	P	C	O
1208	8	P	P	Ad	P	C	O
1200	8	P	P	Ad	P	O	O
1184	8	P	P	Ad	P	C	O
1170	8	P	P	Ad	P	C	O
1162	8	P	P	Ad	P	C	O
1163	8	P	P	Ad	P	C	O
1075	8	P	P	Ad	P	C	C-U
1173	8	P	P	Ad	P	O	O
1175	8	P	P	Ad	P	C	O
1183	8	P	P	Ad	P	C	O
1126	8	P	P	Ad	P	C	O
1127	8	P	P	Ad	P	C	C-U
1142	8	P	P	Ad	P	O	O
1133	8	P	P	Ad	P	C	O
1088	8	P	P	Ad	P	O	O
1085	8	P	P	Ad	P	O	O
1005	8	P	P	Ad	P	C	O
1012	8	P	P	Ad	P	C	O
1013	8	P	P	Ad	P	C	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE SIXTEEN—MALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1103	8	P	P	Ad	P	O	O
1041	8	P	P	Ad	P	C	C-U
1049	8	P	P	Ad	P	C	O
1037	8	P	P	Ad	P	O	O
1020	8	P	P	Ad	P	C	O
994	8	P	P	Ad	P	O	O
992	8	P	P	M	P	O	O
993	8	P	P	Ad	P	O	O
1267	8	P	P	Ad	P	O	O
1224	8	P	P	Ad	P	O	O
1367	8	P	P	Ad	P	O	O
1376	8	P	P	Ad	P	O	O
1375	8	P	P	Ad	P	O	O
1374	8	P	P	Ad	P	O	O
1373	8	P	P	Ad	P	C	O
1372	8	P	P	Ad	P	O	O
1371	8	P	P	Ad	P	O	O
1370	8	P	P	Ad	P	O	O
1369	8	P	P	Ad	P	O	O
1366	8	P	P	Ad	P	O	O
1365	8	P	P	Ad	P	O	O
1364	8	P	P	Ad	P	O	O
1363	8	P	P	Ad	P	O	O
1362	8	P	P	Ad	P	C	O
1361	8	P	P	Ad	P	C	O
1360	8	P	P	Ad	P	O	O
1350	8	P	P	Ad	P	O	O
1358	8	P	P	Ad	P	O	O
1339	8	P	P	Ad	P	O	O
1298	8	P	P	Ad	P	O	O
1294	8	P	P	Ad	P	O	O
1284	8	P	P	Ad	P	C	O
1353	8	P	P	Ad	P	O	O
1357	8	P	P	Ad	P	O	O
1356	8	P	P	M	P	O	O
1355	8	P	P	Ad	P	O	O
1354	8	P	P	Ad	P	O	O
1352	8	P	P	Ad	P	O	O
1351	8	P	P	Ad	P	O	O
1350	8	P	P	Ad	P	O	O
1349	8	P	P	Ad	P	O	O
1348	8	P	P	Ad	P	O	O
1347	8	P	P	Ad	P	C	C-U
1346	8	P	P	Ad	P	O	O
1345	8	P	P	Ad	P	O	O
1344	8	P	P	Ad	P	O	O
1343	8	P	P	Ad	P	O	O
1342	8	P	P	Ad	P	C	O
1340	8	P	P	Ad	P	O	O
1337	8	P	P	Ad	P	O	O

*ABBREVIATIONS

A—absent
P—present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

AGE SIXTEEN—FEMALE*

X-RAY NUMBER	NUMBER OF CARPALS PRESENT	EPIPHYSIS OF RADIUS PRESENT	EPIPHYSIS OF ULNA PRESENT	APPEARANCE OF STYLOID PROCESS OF EPIPHYSIS OF THE ULNA	SESAMOID BONE OF THUMB PRESENT	UNION OF EPIPHYSES OF METACARPALS AND PHALANGES	UNION OF EPIPHYSIS OF THE ULNA OR RADIUS
1205	8	P	P	Ad	P	C	O
1378	8	P	P	Ad	P	C	O
1086	8	P	P	Ad	P	C	C-U
1066	8	P	P	Ad	P	C	O
1027	8	P	P	Ad	P	C	C-U
1006	8	P	P	Ad	P	C	C-U
1276	8	P	P	Ad	P	C	O
1076	8	P	P	Ad	P	C	O
1220	8	P	P	Ad	P	C	O
1392	8	P	P	Ad	P	C	O
1391	8	P	P	Ad	P	C	C
1390	8	P	P	Ad	P	C	C-U
1389	8	P	P	Ad	P	C	O
1388	8	P	P	Ad	P	C	O
1387	8	P	P	Ad	P	C	O
1386	8	P	P	Ad	P	C	O
1381	8	P	P	Ad	P	C	C-U
1380	8	P	P	Ad	P	C	O
1377	8	P	P	Ad	P	C	C-U
1336	8	P	P	Ad	A	O	O
1419	8	P	P	Ad	P	O	O
1423	8	P	P	Ad	P	C	O
1400	8	P	P	Ad	P	C	C-U
1410	8	P	P	Ad	P	C	O
1417	8	P	P	Ad	P	C	C-U
1403	8	P	P	Ad	P	C	O
1402	8	P	P	Ad	P	C	O
1401	8	P	P	Ad	P	C	C-U
1413	8	P	P	Ad	P	C	O
1412	8	P	P	Ad	P	C	C-U
1406	8	P	P	Ad	P	C	O
1416	8	P	P	Ad	P	C	O
1415	8	P	P	Ad	P	O	O
1407	8	P	P	Ad	P	C	C
1405	8	P	P	Ad	P	C	C-U
1414	8	P	P	Ad	P	C	O
1409	8	P	P	Ad	P	C	C-U
1418	8	P	P	Ad	P	C	C-U
1393	8	P	P	Ad	P	C	C-U
1399	8	P	P	Ad	P	O	O
1382	8	P	P	Ad	P	C	O
1383	8	P	P	Ad	P	C	C-U
1394	8	P	P	Ad	P	C	C-U
1396	8	P	P	Ad	P	O	O
1395	8	P	P	Ad	P	C	C-U
1397	8	P	P	Ad	P	C	C-U
1404	8	P	P	Ad	P	C	C-U(?)
1384	8	P	P	Ad	P	C	C-U
1398	8	P	P	Ad	P	C	C
1385	8	P	P	Ad	P	C	C-U

*ABBREVIATIONS

A—absent
P—Present
O—open
M—modified
Ad—advanced
(?)—uncertain
U—ulna
C—closed

(To be continued.)

DEPARTMENT OF
ORAL SURGERY, ORAL PATHOLOGY AND SURGICAL ORTHODONTIA

Under Editorial Supervision of

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MAXILLOFACIAL PROSTHESIS*

By Roy L. Bodine, D.D.S., Washington, D. C.

Captain, Dental Corps, U. S. Army

THE term *maxillofacial prosthesis* as used today includes all mechanical procedures incident to the treatment and repair of injuries to the face and jaws as well as the artificial replacements of those parts. It may conveniently be divided into three principal divisions:

1. Splints for fractures of the jaws.
2. Surgical scaffolding.
3. Prosthetic restorations.

The experiences of the World War demonstrated that no one possessed the combination of training in delicate mechanics, knowledge of the anatomy of these regions, and perception of color harmony and esthetics to as great an extent as did the prosthodontist. He knows the working of metals and other materials, his fingers have been trained to carve accurate and lifelike reproductions of natural organs, and his eye has developed a sense of proportion of size, form and color, all of which is essential to success in this field. Few oral surgeons have either experience or interest in mechanical construction, hence the services of two specialists are necessary—the oral surgeon and the prosthodontist. Gillies expressed it well when he said that he was fortunate beyond those who worked in other fields of surgery in that his instrument maker was also his professional colleague.

SPLINTS FOR FRACTURES OF THE JAWS

The published reports of cases treated during the war by Hayes, Valadier, Kazanjian and others demonstrated that prior methods of treating those fractures which require splinting were obsolete; yet, although more than a decade

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has elapsed since the armistice, little change has been made in the textbooks dealing with these injuries. The vulcanite openbite interdental splint, bulky, fragile, and unsanitary, is still recommended in standard works, and no serious attempt has been made to systematize mechanical appliances used in the treatment of facial injuries. The coming of the automobile, and in the near future the more general use of the airplane, give increased importance to the diffusion of knowledge in this specialty. No other class of injury requires more immediate attention for the best results, and in no other part of the body are the results of faulty treatment so painfully evident, both in function and in appearance. Other deformities may be disguised by clothing, and attract little attention, but facial disfigurements arouse a feeling of aversion which influences the entire economic and social life of the individual. The importance of the subject cannot therefore be overemphasized.

Splints can be classified according to the time of treatment into: first-aid, fixation, and reconstruction.

FIRST-AID SPLINTS

First-aid splints are primarily for the purpose of temporarily immobilizing the parts, usually to prepare the patient for transportation. Fracture cases in which the parts are immobilized at once arrive at the hospital with much less shock; pain is reduced and the morale of the patient is greatly improved. If definitive treatment such as wiring cannot be undertaken immediately, temporary splinting will add materially to the comfort of the patient during the period of waiting.

Three types of first-aid splints are worthy of consideration. The first is a modification of the splint devised by Dr. Hammond of Paris for use during the Franco-Prussian War and consists of a rigid wire, bent to conform to the labial and buccal surfaces of the teeth and attached to them by ligatures (Fig. 1). The wire should have lugs of some kind on its outer surface to prevent longitudinal displacement of the ligatures. This splint will care for Class I fractures of the mandible and for partial fractures of the maxilla.

The second type consists of light impression trays with the handles removed, trimmed so that only a small flange remains on either side of the occlusal portion, filled with a small amount of modeling compound, placed over the teeth of the fractured jaw and held until the compound hardens (Fig. 2). This is probably the more efficient arrangement, and in addition is much easier to apply. As described, it will take care of all Class I fractures of the mandible and all partial fractures of the maxilla. For Class II or III fractures of the mandible a bandage would also be necessary, to keep the edentulous fragments in position; in complete fractures of the maxilla, extraoral arms would be needed, attached by some means to cranial anchorage (Figs. 3 and 4). The extraoral arms are ligated to the buccal flange of the tray and are prevented from rotating by right angle extensions passing through holes at the distal ends of the flange and resting on the inner floor of the tray.

The third method is applicable only to fractures of the mandible, preferably at or near the symphysis. It consists of two tongue depressors, tied

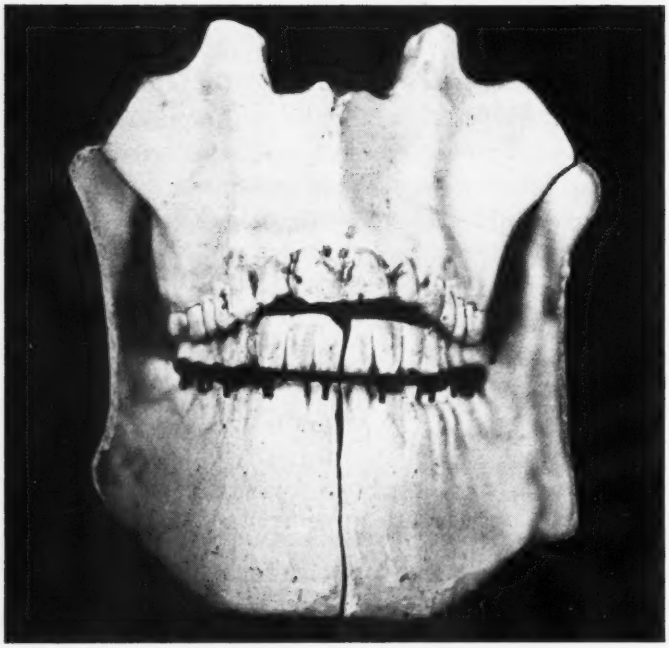

Fig. 1.—First-aid splint. Labial arch, ligated to the teeth, with lugs to prevent longitudinal displacement of ligatures. For Class I fractures of the mandible or Class I fractures of the maxilla.

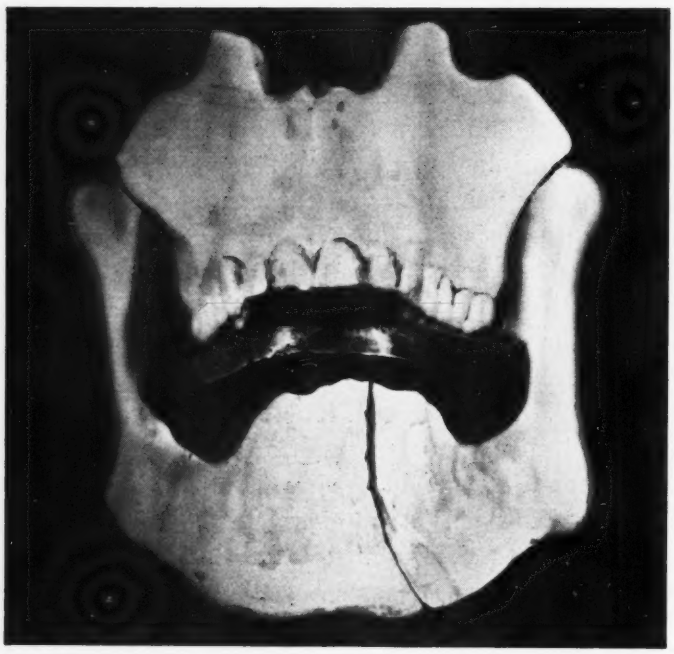

Fig. 2.—First-aid splint. Impression tray with handle removed and flanges narrowed, containing impression compound. For Class I fractures of the mandible or Class I fractures of the maxilla.

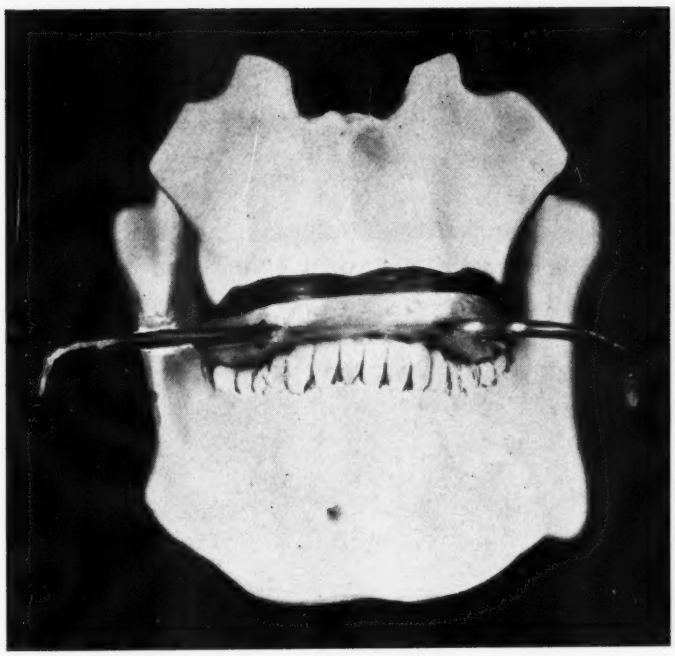

Fig. 3.—First-aid splint. Impression tray provided with extraoral arms for cranial anchorage. For Class II or III fractures of the maxilla.

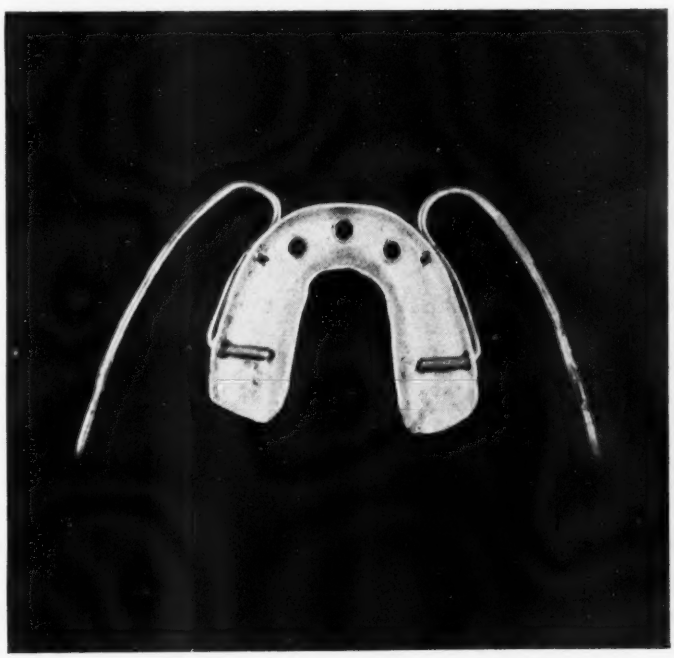

Fig. 4.—Showing the extensions of the arms which pass through holes in the flanges and rest on the floor of the tray, preventing rotation of the arms. The arms are ligated to the tray in the canine region.

together at the lower ends with ligature wire, and attached at the temporal region with adhesive. The lower ends are placed in the mouth where they engage the lingual surfaces of the lower teeth, thus preventing collapse of the mandibular fragments (Fig. 5). This method is credited to Dr. R. P. McGee.

Temporary reduction of the fracture, giving increased tongue space and improved respiration, is well worth the little time required.

FIXATION SPLINTS

Fixation splints comprise the appliances necessary for the reduction of the fragments and their retention in proper position until union has occurred. This is the time when proper splinting means everything to the patient, both

Fig. 5.—First-aid splint. Wooden tongue-depressors, bound together at their lower ends with ligature wire, engaging the lingual surfaces of the lower incisors, and retained by means of gauze or adhesive in the temporal region. For Class I or II fractures of the mandible.

as to length of hospitalization and the end-result. If the proper splint is applied, healing will begin at once and union will take place in a few weeks time; or in cases with loss of substance the parts will be held in their proper position without shrinkage of tissue or contraction of muscles until infection has been controlled, when the necessary bone-grafting operations can be performed. By this means the entire course of treatment will be materially shortened. On the other hand, improper splinting means poor position of fragments, fibrous union in malposition, and extensive reconstruction work

before a satisfactory result can be obtained; even then the end-result is rarely as satisfactory as though earlier treatment had been successful. Most of the reconstruction work consists in undoing, or correcting the results of earlier work which was improperly done.

It must be emphasized that only a small proportion of jaw fractures require any type of splint. At least 95 per cent of the peace time fractures of the jaws and many of the war injuries can best be handled by more simple means, usually intermaxillary wiring. Only when conditions present which preclude wiring are splints indicated.

REQUIREMENTS OF FIXATION SPLINTS

The Proper Reduction of the Fracture.—This, of course, is the primary purpose of the splint, and is the most important requirement. Its attainment is dependent upon accuracy in all things. *First,* accuracy in design. Consideration must be given to the anatomy of the parts, the direction of the fracture, the amount of displacement, the direction of the muscle-pull on each fragment and necessary means of antagonizing it, and the end-results desired. *Second,* accuracy in construction, including impressions, models, occlusal relations and all mechanical technic. *Third,* accuracy in cementation, for unless this step is carefully done and all of the parts seated in the splint in exactly the position intended, all of the previous effort is wasted.

Firm Fixation of the Fragments.—After the fracture is reduced the splint must maintain the parts in exact position, without allowing movement of the fragments or loosening of the splint. One minute's slip may undo the work of months. Study of the stresses involved and design in conformity with them, close adaptation of the splint to the teeth which it encapsulates, and care in cementation are all necessary for the attainment of this requirement.

Provision for Emesis.—The tale of the large loss of British soldiers while crossing the Channel, due to the lack of provision in their splint work for the escape of vomitus, gained wide circulation. Whether this story is true or not, the American authorities were very careful to see that our soldiers were properly safeguarded in this respect, prior to embarkation. It is of primary importance in all splint work, for while nausea will be rarely encountered, its consequences in the case of a tightly locked splint are so tragic that it must always be provided for. Unless missing teeth give ample room, small shears should be kept on the person of the patient in all wired cases, and provision for quickly unlocking all closed-bite splints should be made. These are the three primary requirements, and are the most essential ones; but the following additional factors must also be kept in mind.

Strength.—Consideration must be given to the direction and amount of stress that may possibly be applied to a splint, and provision made for sufficient strength in the parts to take care of it, with a generous margin of safety. A broken splint necessitates its removal, repair and replacement. To remove a splint when consolidation has just begun may result in considerable injury to the patient, and the time necessary for the repair of the splint may allow movement of fragments and tissue changes sufficient to

greatly delay if not seriously endanger the final successful outcome of the case. Given reasonably careful laboratory technic, there should be no broken splints. Their occurrence is a reflection on either the judgment or the mechanical skill of the one who constructed it.

Simplicity.—All splints should be constructed as simply as possible; and the fewer parts that can be used to attain the desired result the better for both patient and operator. A simple jackscrew, placed carefully in line with the desired movement, at the point of greatest leverage, is much more efficient than any complicated arrangement of levers and joints, which, no matter what the degree of technical skill exhibited in their construction, always look more like one of Goldberg's cartoons than an efficient mechanical appliance.

Hygiene.—The cleanliness of the appliance must be kept in mind. All surfaces should, if possible, be accessible for cleansing, either by a toothbrush or by the instruments of the hygienist. This is an additional reason for avoiding all complicated mechanisms. Smooth surfaces assist in the cleansing of the apparatus, and all pits and crevices should be filled in with solder. Gold plating of the metal parts assists in the prevention of accumulations.

Comfort of Patient.—If the foregoing requirements have been met, the appliance should be as comfortable as would be possible to construct. If it is simple and hygienic, very little more can be done. Undue bulk must not be used in an attempt at strength, as the smallest splint will seem very cumbersome to the patient. Two things must be particularly guarded against: first, care must be taken not to place lugs, set-screws, springs, nuts, etc., where they will cut or irritate the delicate mucous membrane of the lips and cheeks; second, do not place jackscrews or bars where they will unduly interfere with the movement of the tongue. These are little things, but they are the things which annoy the patient and tend to lower his morale. After the fracture has been reduced and the inflammation has subsided the patient will experience very little pain from the fracture itself; and anyway, to him that pain will be part of the accident and will be taken for granted; but irritation from a faulty splint will persist, giving him constant pain, and in addition providing him with a grievance, directed against the one who constructed it. The long period of convalescence in these cases, during which the patient is otherwise perfectly well, is exceedingly hard on his morale, and he is quite likely to magnify his discomforts.

Ease of Construction.—Time is an important element in fracture cases, and the earlier the splint is inserted the better. Therefore, the design should be such that it will not require too much time for its construction. Two or three days should be the maximum time required, including the taking of the impressions and the cementing of the splint.

Ease of Application.—The insertion of a splint depends for its success upon the care with which it was designed. Consideration must be given to the question of the necessary procedure. Can the fracture be reduced, the teeth kept dry, and the splint seated, before the cement hardens, or will it be

necessary to cement a section of the splint to each fragment and lock them together later? Can the fracture be reduced immediately, or must provision be made for a gradual reduction? Is sufficient pain likely to be caused to require a general anesthetic? These points must also be considered, while designing the splint.

Ease of Removal.—If the splint has too much bulk the problem of removing it without a refracture or the extraction of a loosened tooth may not be so simple as it sounds. It is difficult to draw the line between a splint that is too light to stay on, and one that is so heavy that it would be difficult to remove, but it is better to err on the side of excess strength rather than fragility. Too little strength involves the possibility of injury to the patient.

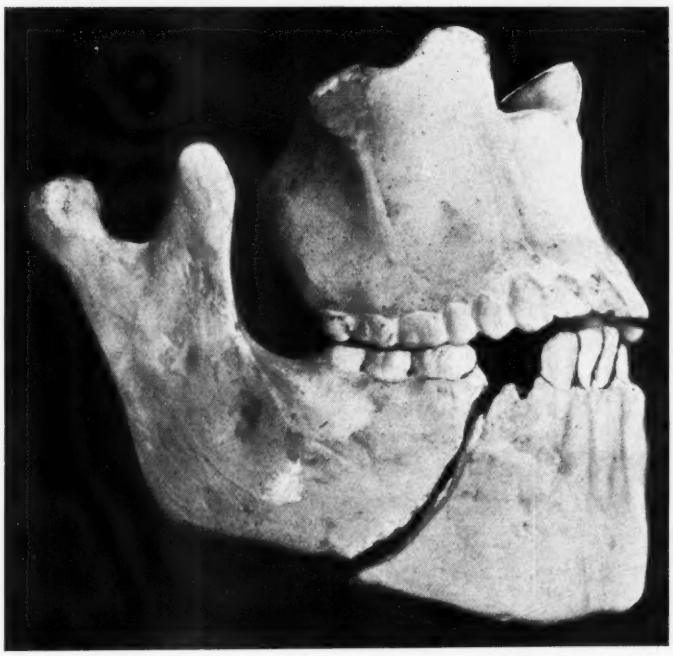

Fig. 6.—Class I fracture of the mandible. A simple case with adequate dental anchorage available in each fragment.

while too much strength only means trouble for the operator. Given time, patience and a careful operator, any cast splint can be removed without injury to the patient.

CLASSIFICATION OF SPLINTS

Many fracture classifications have been devised by men who studied the injuries of the face and jaws, but most of them have been concerned chiefly with the surgical aspects of the problem, and their only object was to locate the fracture anatomically. A typical example of a classification depending on extra-dental conditions is that of Georges Villian, who classified fractures according to their location as compared to the musculature, such as: Intra-Depressor, Pre-Elevator, Intra-Elevator, etc. While a consideration of muscle action is essential to the proper designing of a splint, the selection of the basic type to be used depends much more upon the anchorage available, in

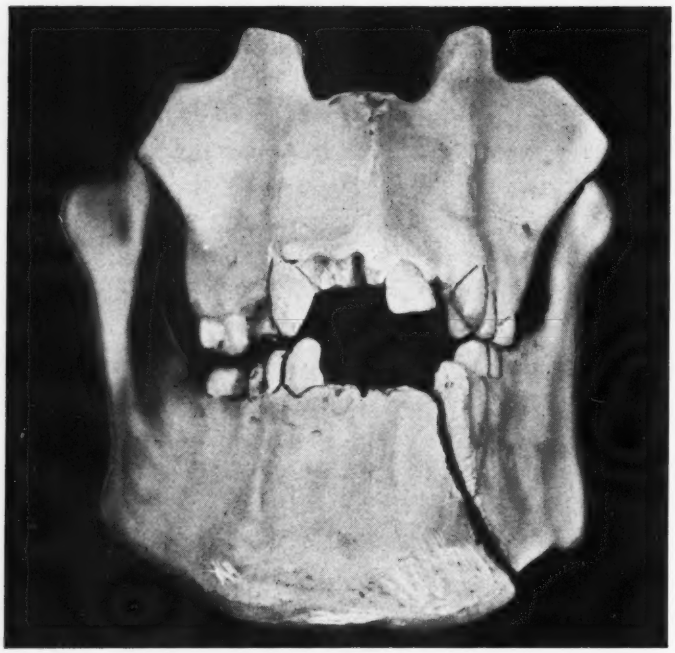

Fig. 7.—Class I fracture of the mandible. A more involved case, with few teeth available for anchorage.

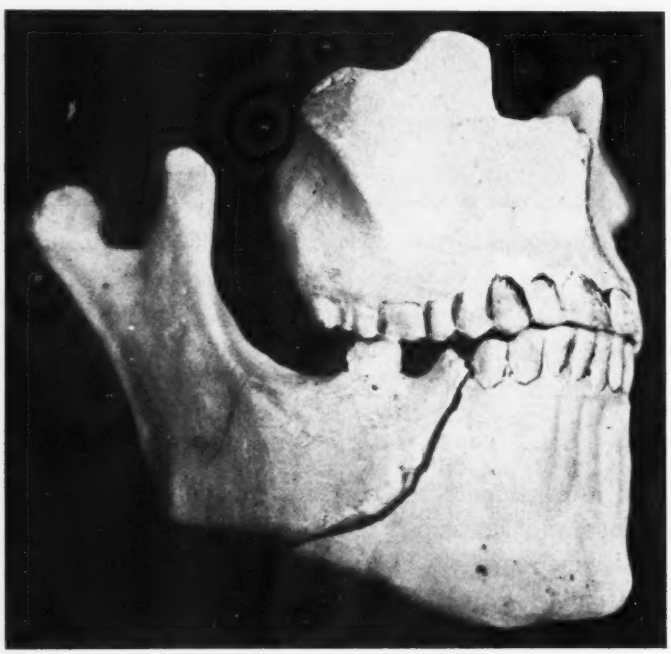

Fig. 8.—Class I fracture of the mandible. The single tooth in the posterior fragment affects the splint design.

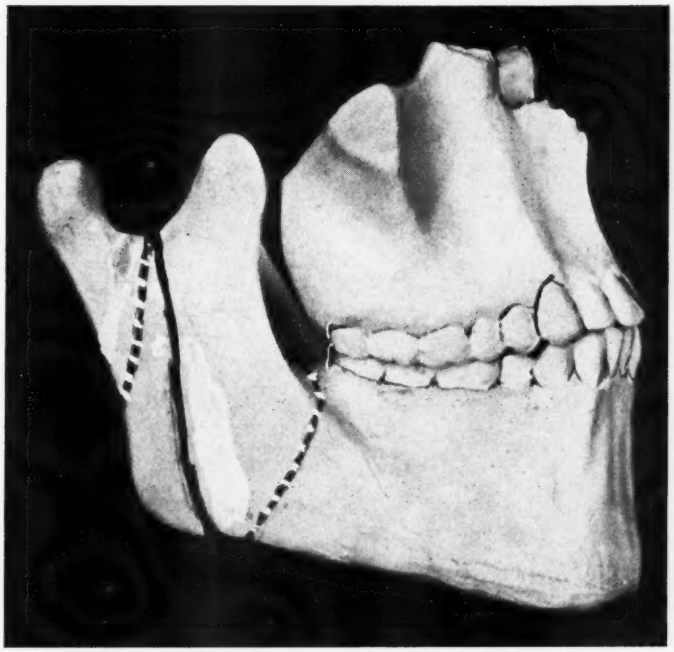

Fig. 9.—Class II fracture of the mandible showing buccal displacement of the posterior fragment. Dotted lines indicate other common fracture-lines, posterior to the last tooth.

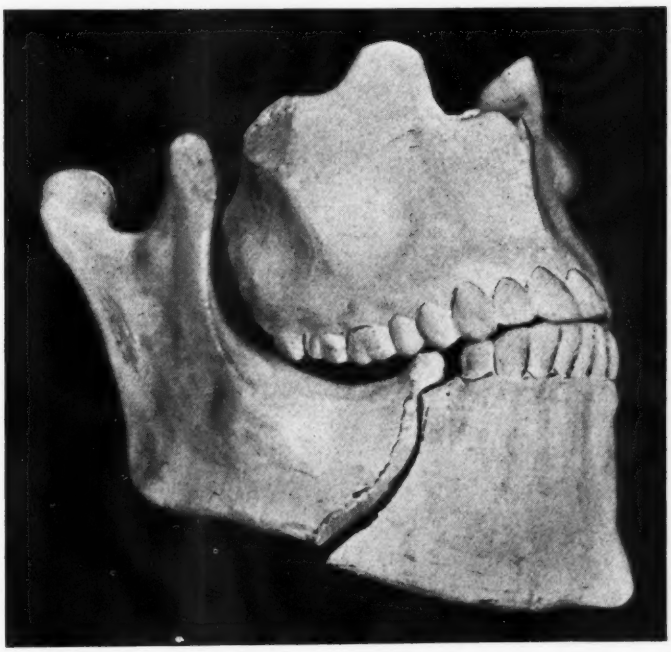

Fig. 10.—Class II fracture of the mandible. Larger edentulous fragment.

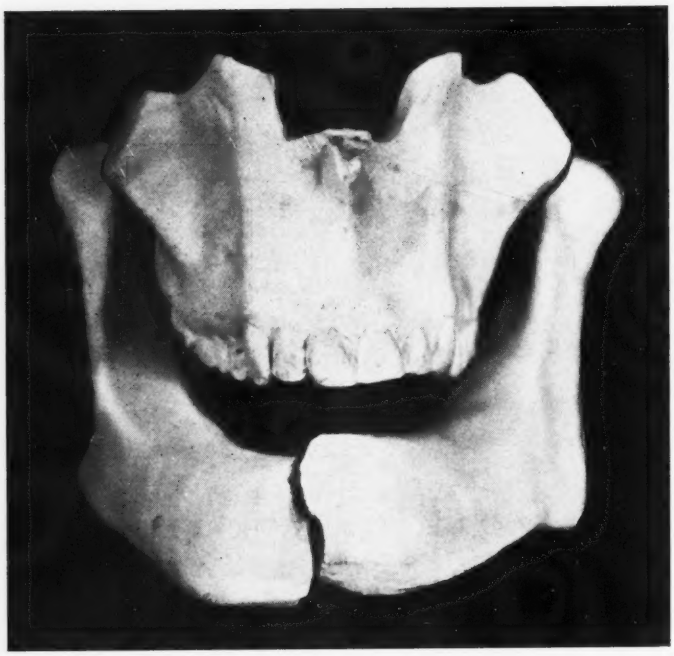

Fig. 11.—Class III fracture of the mandible. Completely edentulous.

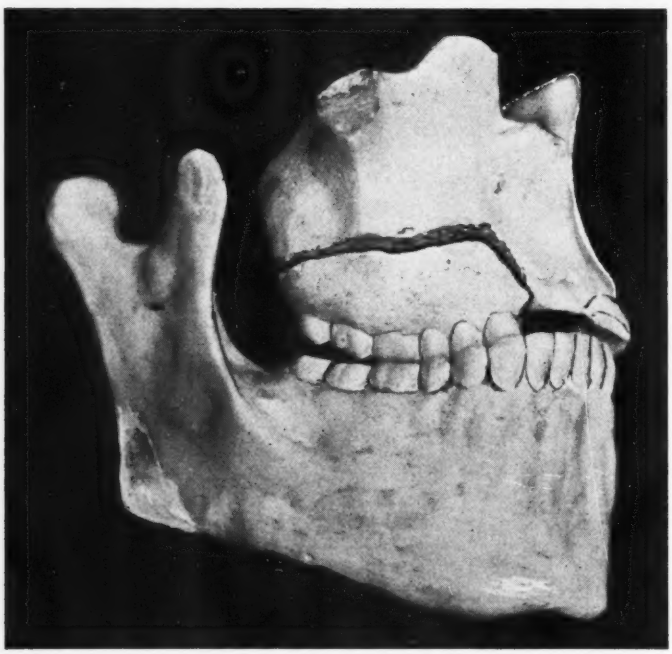

Fig. 12.—Class I (partial) fracture of the maxilla, showing downward and inward displacement of the fragment.

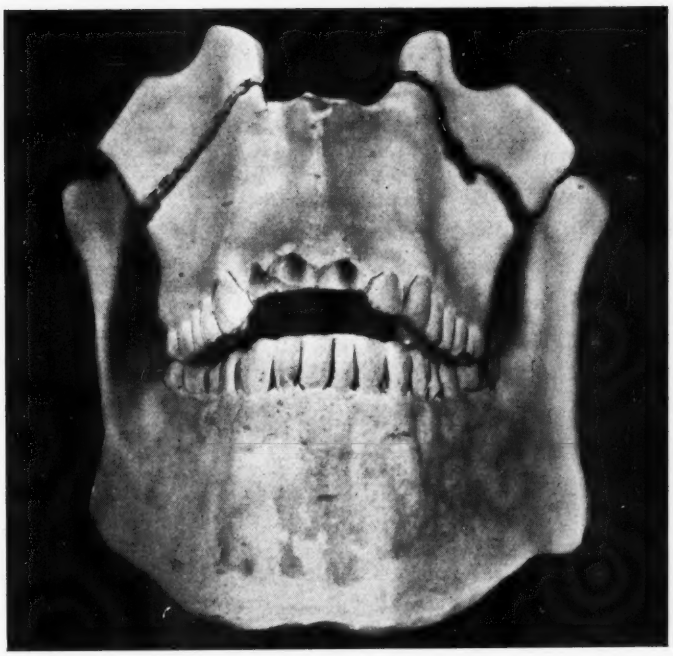

Fig. 13.—Class II (complete) fracture of the maxilla. Downward and backward displacement.

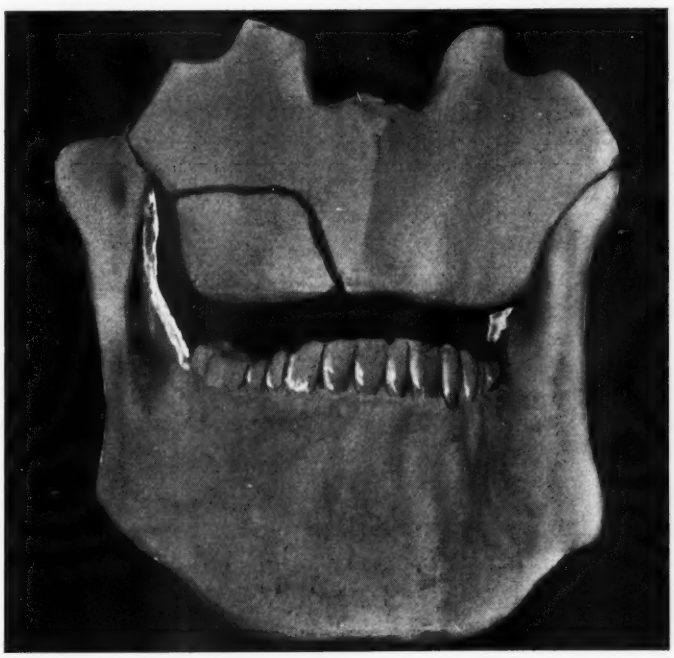

Fig. 14.—Class III fracture of the maxilla. Completely edentulous. The fracture may be either partial or complete.

other words upon the number of serviceable teeth remaining in the fragments. The foundation is the starting point in the erection of any structure. The classification adopted herein follows to some extent that of Kazanjian, in which the teeth are the determining factors.

Fractures of the Mandible.

Class I. Fractures with teeth in each fragment. (Figs. 6, 7, and 8.)

Class II. Fractures with an edentulous posterior fragment. (Figs. 9 and 10.)

Class III. Fractures in edentulous cases. (Fig. 11.)

Fractures of the Maxillae.

Class I. Partial fractures, with teeth in each fragment. (Fig. 12.)

Class II. Complete fractures, with teeth in each fragment. (Fig. 13.)

Class III. Fractures, either partial or complete, in edentulous cases. (Fig. 14.)

In classifying the case, all teeth in line of fracture, or whose vitality is impaired to a sufficient degree to necessitate their extraction, are considered to have been eliminated.

(*To be continued.*)

NOTE.—This is the first of a series of articles by Captain Bodine. The next will appear in an early issue.

DISEASES OF THE MOUTH*

BY STERLING V. MEAD, D.D.S., WASHINGTON, D. C.

HEALTH is our greatest asset. A clean mouth and sound teeth have a tremendously important bearing on the physical condition and efficiency of an individual. The mouth is subject to as great a variety of diseases as any other part of the system, although their multiplicity is not always appreciated. Diseases of the mouth may be either local in character or they may constitute part of the picture of general disease. While it has been recognized by many for years that oral sepsis causes many systemic disturbances, it has been only recently that we have learned to know the advantages and real necessity for a close cooperation between physicians and dentists in handling these cases. The dentist has learned that he may usually expect the most unselfish cooperation from the physician, and in return it is expected of him that he limit his activities where the service can be better performed by the physician, surgeon, or specialist, and endeavor to aid the medical man in his effort to eliminate all pathologic mouth conditions.

While it has been common practice in the past for the dentist to consider the maxillary sinus his special field, I am sure it has been our experience in Washington and in many other localities, that the most good may

*Read before the District Medical Society, Washington, D. C., Nov. 23, 1927.
Reprinted from The Journal of Laboratory and Clinical Medicine, October, 1928.

be accomplished by the dentist handling the mouth factors and lending any further service he can to the rhinologist. This is true of many other medical and surgical problems. I believe that the sooner mouth wounds communicating with the maxillary sinuses are closed, and further treatment turned over to the rhinologist, the better the results.

In the study of treatment of diseases of the mouth, I believe it is generally conceded that diagnosis is of paramount importance. A correct diagnosis is imperative before the prognosis can be given and the proper treatment instituted. There can be but one true diagnosis, but many forms of treatment in the hands of different men may accomplish the same result. A thorough understanding of all of the diagnostic methods is essential for the successful treatment of a patient who has come to the physician or to the dentist for the relief of disturbing symptoms.

A mouth examination should be conducted in a routine manner and the results recorded upon some suitable record chart.

A very common misconception of the proper diagnostic methods is the practice of many physicians in referring patients to the dentist for a radiographic survey of the mouth with a request for a radiographic report, and there is a very prevalent idea that the only prerequisite for a mouth diagnosis is the ability to take good radiograms. If a radiographic examination is to be of any great value, it should be taken by a dentist or physician schooled in x-ray technology and the fundamental principles of diagnosis, and whose experience in this field gives a more correct interpretation. The fact should not be overlooked that radiograms of the teeth are in most cases useless without considering the findings of the other diagnostic methods such as history, manifestations of pain, general oral examination, percussion and palpation, exploration, color, conductivity of temperature, transillumination, electric pulp test, bacteriologic examination, histopathologic examination, blood, and other laboratory methods. There also seems to be a very general idea that the pulpless tooth is the only source of oral sepsis, causing systemic disturbances. This is only one of many factors. A vital tooth may in some instances show periapical disease. Periodontal diseases, and especially periodontoclasia, are present in the mouths of most adults.

Other etiologic factors to be considered are: stomatitis of various types, impacted and unerupted teeth, fractures, periostitis, rarefying and condensing ostitis, acute and chronic osteomyelitis, necrosis, ostitis serrata, exostosis, myositis ossificans, radicular, follicular and multilocular cysts, and benign and malignant tumors, etc.

The value of radiography should not be misunderstood. It is relative, as one views the abnormal area by contrast. A radiolucent or radiopaque area may be hidden or distorted by exposure from different angles, interposing tooth roots or dense bone, and thus many infected areas may be overlooked. Pathologic areas and areas undergoing regeneration following operation should be compared with other similar areas in the mouth and contrasted. Good radiograms are rarely misleading if properly interpreted, but their possibilities are limited and the vital factor in determining the presence or absence of disease must be the final clinical examination. It has been my

experience that the postoperative results are usually more pronounced than the radiogram would indicate.

Inflammation is a cellular defensive reaction against injury, and infection is not the only element causing this injury, as it may be due to trauma, chemicals, heat, cold, or electricity.

As a result of inflammation rarefaction or condensation of bone may result, or they may both occur simultaneously. Therefore, rarefaction is indicative of inflammation, which may possibly be from infection, and causes the radiolucent radiographic appearance. Inflammation may cause an increased density of the bone lamella and results in a radiographic radiopacity.

The electric pulp tester is a valuable diagnostic agent when used with transillumination and the radiogram, but is not reliable when used independently.

Transillumination of the teeth, gums, and sinuses is indispensable. The radiogram may be absolutely negative as there may be no bone pathology shown and transillumination may show definite disease, and in some cases both of these methods may be negative and disease may be present. Transillumination is a valuable aid in making a diagnosis of mouth conditions, but it has its limitations. It is unreliable in disclosing areas of periapical infection, and it does not disclose bone pathology, except where it extends to the soft tissues. In other words, the pathology, shown by transillumination, is due to soft tissue infection.

The fact that the alveolus and gums do not show a shadow, when transilluminated, does not eliminate the possibility of infection. My experience is that it is usually not possible to detect periapical infection by transillumination where the periapical disease is not accompanied by periodontal disturbances.

One of the perplexing problems of oral diagnosis is the unerupted or impacted tooth, as it should always be considered questionable even though no definite symptom of pathology is shown. While it is possible in some instances for pressure of an impaction to give reflex disturbances, I do not believe this usually occurs without local symptoms, but I do believe that the ostitis and infection about the impaction are the important etiologic factors so far as systemic disturbances are concerned.

The removal of impacted third molars more than any dental operation is attended with serious consequences. Anyone who has attempted much of this work will have experienced some very serious results. While, as many of you realize, this in many cases is a dangerous procedure, it is difficult to educate the public that it is as important to have the proper postoperative care in these cases as in tonsil and other operations.

It takes experience to teach one that it is better not to remove one of these teeth, than to do so and have the patient not remain or fail to return for treatment. I believe we will learn to hospitalize these patients more and more.

A periodontal disease is a disturbance of the periodontal tissues. It includes all diseases of the tissues surrounding the tooth root which have their origin in the gingivae, periodontal membrane, and gums.

The term "pyorrhea" which is quite widely used in speaking of these conditions has given rise to a great deal of confusion, as pyorrhea, or Rigg's disease, is described as a loosening of the teeth associated with continued suppuration. There are various stages of periodontal involvement, and the initial lesion is not associated with suppuration, but only with simple inflammation. The term "pyorrhea," therefore, does not convey any idea as to the state of involvement of the tissues. Under periodontal disease we consider the different forms of recession, gingivitis, hypertrophy, pericementitis, and periodontoclasia.

Unfortunately the pulpless tooth problem is one of the phases of our work upon which there is a difference of opinion.

Radiographically the pulpless tooth may be functional and harmless if the lamina dura is definite, if the surrounding bone cancellations appear to be normal, as compared with adjacent normal teeth; if there are no clinical symptoms of disturbance; if the apex is not hypoplastic and there is a filling well into, but not through, the apex.

In doubtful cases where the vitality test, transillumination, radiograms, and other methods do not show definite infection and it is suspected, the health of the individual must be taken into consideration. The pulpless tooth is in the same category as the tonsils. The diagnosis cannot always be made from the local appearance, but general symptoms must be considered. It is not always possible to examine a tonsil or a pulpless tooth and give a positive assurance that there is no pathology, even in the absence of any apparent infection. Where sepsis is known to exist, and other foci have been eliminated or ruled out, it may be necessary to remove pulpless teeth or to open into suspected pathologic bone areas throughout the mouth, even though no definite infection is apparent.

I do not agree with the radical who condemns every pulpless tooth. I am not pleading for the pulpless tooth, for I am very much afraid of it; but I do believe if the patient will present himself in time, and the pulp is removed aseptically and the canals filled properly that a large percentage of such teeth may be retained. I do not believe an infected tooth apex should be retained a minute, and I would consider it a waste of time to attempt to treat one unless an apiectomy is performed in a selected case.

In determining when to extract a pulpless tooth, it is necessary to take into consideration many factors. Each case should be handled as good judgment and experience indicate, and with but very few exceptions, my practice is to recommend extraction of:

1. All teeth showing evidence of periapical bone involvement.
2. All pulpless teeth in patients whose health is seriously endangered.
3. All pulpless teeth showing marked periodontal bone resorption (periodontoclasia).
4. All pulpless teeth directly bordering on the maxillary sinus.
5. All third molars when pulpless or causing pressure or decay in other teeth.

6. All pulpless teeth when the root formation precludes the possibility of a good root filling.

7. All pulpless deciduous teeth.

If I were to make any specific recommendation for proper cooperation of physician and dentist, I would call attention to the advisability of personal contact. The patient cannot be trusted with reports, as they are so apt to mistinterpret them. If the physician refers a case to the dentist, it would be well to telephone or write to him giving him some idea of the patient's general condition, and what is to be determined. In many cases, it is necessary for the dentist to see the patient after radiograms and other evidence are completed so that a proper diagnosis may be made and an intelligent report and recommendation made. Patients should be taught the value of preoperative and postoperative radiographic examination, as well as laboratory and other diagnostic methods.

It is not enough that a physician advise a patient to go to his dentist and have his teeth looked over. In many instances the patient is at fault when the physician receives an unsatisfactory report, as he fails to advise the dentist what is wanted.

It is inconceivable and unfortunate that after more than fifteen years of close study on the part of medicine and dentistry, there is still a divided opinion regarding the rôle of oral sepsis. Dentistry has many unsolved problems and much should be accomplished in the field of prevention, and care of the mouth.

We hear a great deal about education of the public in regard to early recognition of stomatitis and tumors of the mouth, but I wonder just how many physicians and dentists are able to diagnose these mouth conditions when they see them. I believe that it is apparent to all that there is great need for a more thorough study of mouth conditions, and proper training of both the physician and the dentist, to enable him to recognize the character and significance of the many oral abnormalities.

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ABSTRACT OF
CURRENT LITERATURE

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA
DENTAL RADIOGRAPHY
By Dr. Edward Preble, New York City

NUTRITION AND PEDIATRICS
By Dr. Samuel Adams Cohen, New York City

It is the purpose of this Journal to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Orthodontia, Oral Surgery and Radiography

Liver Diet for Pernicious Anemia and the Dentist. M. Schwab, Berlin, Zahnärztliche Rundschau, Aug. 12, 1928, xxxvii, 33.

The author who is a practicing physician, not a dentist, reminds the stomatologists that they may be the first to have pernicious anemia brought to their attention and long before such cases reach the family physician. This is due to the fact that such phenomena as bleeding from the gums, glossitis, etc., may develop at an early period. Under these circumstances would the dentist be justified in treating a patient who refused to consult his physician? He might feel that by reason of the bleeding gums he has the right to put the patient on a diet of liver or one of the numerous stable preparations now on the market. Ordinarily of course it would be the proper course merely to recommend the patient to consult his medical attendant and thus be rid of all responsibility. The author proceeds to inform the dentist readers of the Rundschau as to the origin of the liver treatment and its technic; but since the innovation is purely American and has been widely written up in our lay periodicals it is probable that the average American dentist is already familiar with the essentials. The treatment in question has now been introduced throughout the world and over 2000 cases have been treated with not more than 1 per cent of failures. It is too soon to be sure whether these patients must continue to subsist on a diet rich in liver or may be permitted to discontinue it from time to time or entirely. The author believes that the milder cases and those in the earlier stages may be radically cured and here is where the cooperation of the dentist may come in.

Ether Convulsions. Editorial in The Dental Surgeon, September 8, 1928, xxv, No. 1244.

Although ether anesthesia plays a very minor rôle in ordinary dentistry it is of significance in oral surgery and the fact that of very recent years it has now and then been attended by convulsions which may end fatally—at

least in Great Britain—is regarded as important by the editor of *The Dental Surgeon*. The subject has recently received a general discussion before the Section of Anesthesia of the Royal Society of Medicine. The phenomenon is quite distinct from any of the muscular phenomena which have heretofore attended on ether anesthesia and develops at a relatively late stage of the latter. The seizures are of the epileptiform type and several terminations have been recorded. They may pass off without affecting the cardiac and respiratory centers or may go at once to a fatal termination. They have been known to start up anew after patient has been put to bed, and in certain cases may not supervene anew until several hours have elapsed. Attempts to account for them by impurities in the ether or other explanation are not satisfactory. The youth of many of the victims suggests a new susceptibility in the new generation. No treatment has prevailed save the obvious one of discontinuing the inhalations at once. In discussion various causal possibilities were discussed as overadministration, the use of warmed ether, etc. The editorial neglects to mention whether any of the victims were suffering from acidosis as shown by the presence of diacetic acid in the urine; this is with some the explanation of certain cases of ether fatality and furnishes a contraindication to ether anesthesia until the condition can be neutralized. We believe that some of these acidosis deaths were accompanied by convulsions.

"Shuttle Kissing" and Dental Caries. News Item in The Dental Surgeon, Aug. 16, 1928, xxv, No. 1241.

Caries due to a specific cause and occupational caries are subjects of unusual interest. Under the title "A Cause of Teeth Decay" a news item calls attention to the mention in the House of Commons in the course of a debate, of a custom known in Lancashire as "shuttle kissing." The subject was brought up by T. Shaw who stated that nearly every weaver in Lancashire over twenty years of age either had very bad teeth or was wearing a false denture. Thus far no medical opinion has ever been officially forthcoming that the constant "kissing" of the shuttle by the weaver is attended by any danger although obviously it is dirty and disgusting. It is accused of transmitting disease, notably influenza. As many as four weavers succeeding one another on the same loom have left one after another with this disease. In one episode syphilis seems to have been transmitted. But thus far no mechanism has been adduced to account for setting up caries. Much dust is ingested from the weft when this is drawn into the mouth, but this seems to be the sum of the exposure. The under-secretary stated that more data should be forthcoming, which Shaw agreed to supply. The habit can be prevented by installing hand-threaded shuttles.

Report of One Hundred Cases of Hypodermic Needles Broken During Administration of Oral Local Anesthesia. Th. Blum, New York. The Dental Cosmos, September, 1928, lxx, 9.

Having had this accident happen to him an even hundred times, the author reports the entire material in tabular form. The time interval in which

these accidents occurred is fifteen years and in 1923 he had this experience 18 times. Ages of patients varied from six to sixty-nine years and the locality was the mandible in 82 per cent. In 93 per cent the broken needle was of thin steel. About two-thirds of the patients were office cases and the balance were clinical. Although this number (100) seems large at first sight 6 or 7 cases a year is really small considering the large number of these injections which are constantly being made. Few dentists report these accidents, although it would be very advantageous if all such could be placed on record. The author is sure that the percentage of broken needles is constantly diminishing through greater precautions. It is a fact that more needles break off in males, apparently because they are not as good patients as females. The author distinguishes carefully between the technics of mandibular and all other injections, the latter coming under the head of infiltration anesthesia. The former receives a detailed account.

Nutrition and Pediatrics

Growth of Rats on Vegetarian Diets. Nsien Wu and Daisy Yen Wu. Chinese Journal of Physiology, April, 1928, ii, 2.

In view of the fact that the diet of the majority of the Chinese people is largely vegetarian, Wu and Wu, in a preliminary report, tell of their experiences with the vegetarian diet with the laboratory animal of the omnivorous type. The animal chosen was the four-week-old albino rat.

Since a purely vegetarian diet, consisting of cereal and legumes, does not contain enough vitamins and minerals, leafy vegetables were added to supplement the deficiencies of the cereal-legume ration.

As a result of an interesting series of experiments which included the feeding of the albino rats with all the common cereals, legumes and some twenty varieties of vegetables, these authors have found no combination of them comparable with the standard diet. Likewise Slomaker in 1912 concluded that strictly vegetarian diet was not suitable for the nutrition of an omnivorous animal. In 1916 McCollum and his associates obtained similar results, and in 1925 they state that while there is nothing in vegetarianism per se which makes it impossible for an animal of the omnivorous type to be satisfactorily nourished, it is by no means a simple matter to secure the optimum of well-being with vegetarian diets.

Wu and Wu noticed that the young of even the best vegetarian rats are markedly undersized, which again raises the question of the direct relation between the diet and the stature of the Chinese. These authors further feel that the chief cause of failure of young rats to grow normally on vegetarian diet seems to lie in its low calcium content.

Since the metabolism of the rat has been shown to be very similar to that of the human being who for many thousands of years has been also omnivorous, it seemed justifiable to these writers to conclude that optimum nutrition of human beings cannot be obtained with purely vegetarian diets.

Beriberi Columbarium. Lieut. Colonel R. McGarrison. Indian Medical Research Memoirs, March, 1928, No. 10.

The present memoir, which is a continuation of a previous memoir published in 1924, deals with a morbid state, produced under experimental conditions in pigeons, which presents all the pathologic features of human beriberi. As a result of prolonged research on Indian pigeons, Lieut. Colonel McGarrison, an authority on nutrition, reporting from Pasteur Institute, Coonoor, concludes among other things that the basal factor in the production of beriberi columbarium is insufficiency but not complete want of Vitamin B (or of the antineuritic fraction of this vitamin). Moreover, the ultimate cause of the disease is not the negative factor of vitamin insufficiency but a positive and toxic agent produced in the course of a disordered metabolism arising out of insufficiency of Vitamin B in the food.

This authority further concludes that the result of this investigation confirms the generally accepted view that endemic or true tropical beriberi is due to insufficiency of Vitamin B (or the antineuritic fraction of this vitamin) and not to toxic substances produced in rice by bacterial action. McGarrison states, however, that this does not preclude the possibility that other maladies included under the generic term beriberi may have different etiology.

The Nature of the Anoestrous Condition Resulting from Vitamin B Deficiency. A. S. Parkes. Quarterly Journal of Experimental Physiology, May, 1928, xviii, 4.

Parkes observed an abrupt cessation of the estrous cycle in rats in about four weeks by feeding them on diets deficient in Vitamin B, represented by 1 per cent or less of yeast extract added to a basal diet.

He also quotes the investigations of Evans and Bishop who showed in 1922 that underfeeding of rats with an otherwise complete diet resulted in general aberration of the ovulation cycle, and Papanicolaon and Stockard, who found disturbances in the cycle on an unbalanced diet as well as on a diet deficient in salt.

In 1925 the author, in collaboration with Drummond, produced degenerate changes in the testes on Vitamin B deficiency.

Symptomatology of Vitamin B Deficiency in Infants. B. Raymond Hoobler. Journal American Medical Association, Aug. 4, 1928, xci, 307.

In an excellent résumé of the subject, Hoobler of Detroit, who had opportunity to observe cases of infantile beriberi in the tropics, particularly in the Philippines, feels that many of the symptoms of mild and incipient cases of this nutritional disorder have their counterpart in the children's wards of hospitals in this country. This disease is brought on by a diet in which the antineuritic substance Vitamin B is practically deficient.

Characteristic symptoms are presented in infants on or before three months of age who are breast-fed by mothers who may or may not show clinical evidence of beriberi but whose diets are deficient in the antineuritic sub-

stance Vitamin B. Such symptoms may include gastrointestinal disturbances with colic, rigidity, cyanosis, vomiting and constipation with subsequent anorexia and loss of weight. The voice, which is usually feeble and whining, loses its quality and it may be entirely lost. There is a reduction in the amount of urine even to passing only scanty amounts. These infants have pallor and a waxy tinge and are restless and fretful, occasionally having twitching-choreic movements, slight rigidity of the neck, general spasticity and even convulsions. The muscles are tender, being noted especially over the calf muscles and sometimes there is a complete loss of function of the limbs. If this diet is persisted in, the child dies with symptoms of cardiac failure.

In discussing the etiology, Hoobler writes that Vitamin B cannot be stored in the system. Moreover, breast milk cannot be relied on in all cases to supply the optimum quantity of the antineuritic substance and therefore a breast-fed child may be receiving subminimal amounts of Vitamin B. The usual diet of an infant in the United States up to the third month consists of milk, either human or cow's, to which is added sugar and syrup, possibly a milled cereal, with some orange juice and cod liver oil. In this diet only limited amounts of Vitamin B are represented in milk and orange juice.

Hoobler reports his experiences with infants suspected of receiving an insufficient amount of Vitamin B. He fed these infants with one-half teaspoonful daily of concentrated brewers' yeast in addition to their usual diet. As a result, infants who had hitherto been refusing part of their formula gradually increased their intake. He feels that the addition of yeast brought about a better assimilation and utilization of the food intake, resulting naturally in an increase in body weight. Moreover many of the infants who exhibited muscular pains and certain amount of spasticity were relieved.

The writer expresses the hope that others would report their results of similar observations.

The Influence of Yeast on the Alimentary Rate. D. W. Thorup and A. J. Carlson. American Journal of Physiology, February, 1928, lxxxiv, 1.

Thorup and Carlson, reporting from the Physiology Laboratory of the University of Chicago, studied the influence of yeast on the alimentary rate in rats and also on eighty-five volunteers for a period of eight weeks. As a result they conclude that yeast in varying amounts up to 25 per cent has no effect on the alimentary rate in normal rats on an adequate diet. Moreover, they feel that the value of yeast as a laxative in adults on average normal diets is questionable. The authors did find, however, that in rats there is some increase in moisture content of the stool during the period of yeast ingestion and in man yeast has a tendency to produce softer stools either by increase in water content or increase in occluded gas.

From observations of other research workers regarding the effect of yeast on the alimentary rate, the balance of evidence favors some laxative action of yeast, either by the CO_2 production, high Vitamin B content, or change in the intestinal flora.

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EDITORIALS

The Meeting of the New York Society of Orthodontists

THE Fall Meeting of the New York Society of Orthodontists was held at the University Club, Boston, Mass., October 24, 1928.

The Boston members of the New York Society of Orthodontists had arranged for breakfast to be served to the visiting members at the University Club. The business meeting was called to order by the President, Dr. Frank A. Delabarre at nine o'clock at which time the usual routine of business was transacted.

Clyde Keeler, B.S., M.S., M.A., D.S., delivered a paper on "Heredity." A large part of the paper dealt with the laws of heredity as understood by biologists and well known to the average orthodontist. He reviewed some of the inherited anatomic conditions which have been studied by the scientists. He laid particular stress upon the cause of color-blindness. The published

outline of his lecture contained a topic on "The Ontogenetic Development of an Hereditary Limitation," but of this subject he said very little. He was inclined to believe that malocclusions of the teeth were inherited but presented no evidence to substantiate his belief.

We hope at some time that an Executive Committee will arrange a debate on the question "Is Malocclusion Inherited?" We make this request because we have listened to several papers on "Heredity" during the last two or three years in which the lecturers have discussed practically everything except the dental apparatus. They often end up by making the flat statement that "malocclusion is inherited" but they present no evidence to substantiate their claim. Much evidence has been accumulated in the past twenty years by men who have been working on the problem of inheritance and many facts prove that malocclusions and similar deformities cannot be transmitted.

Dr. George C. Ainsworth, organizer of the Ainsworth appliance, gave a lecture on its construction and use. Dr. Ainsworth was one of the earliest operators to use the perpendicular tube on the premolar and molar for the purpose of producing bodily tooth movement. The use of the vertical tube was later featured in the pin-and-tube appliances. Dr. Ainsworth's presentation was of much interest to the young men from a historical standpoint.

Dr. Adelbert Fernald presented a paper on the subject of "Nail Biting" in which he reviewed the medical literature dealing with this habit. He reported his experience with two patients in trying to break them of the habit. He was successful in one patient; the other "relapsed" to nail biting.

Dr. Arthur L. Morse presented a paper on "A Study of Variations in Some Fox Skulls." Dr. Morse showed one skull with a supernumerary tooth, also one mandible with a misplaced incisor, which tends to show that at least some abnormalities appear in the lower animals. If we were to believe some of the statements made by one of the previous speakers on "Inheritance" we would expect the Massachusetts foxes to be handicapped by malocclusion providing the animal possessing the skull which Dr. Morse showed was so fortunate as to produce offspring. Some of the variations which Dr. Morse showed may have resulted from warpage of the mandible during preparation. The mandibles of foxes and long-nosed dogs are exceedingly thin and often warp during the drying of the specimen which would produce variation in the skull which did not exist in the live animal.

The following clinics were presented by the respective members.

1. Different types of anchorage in Jackson Appliances. Fred C. Allen, D.M.D.

2. Teaching specimens from the Harvard Museums. L. W. Baker, D.M.D.

3. Case models. Shinji Fujishiro, D.M.D.

4. Orthodontic joys. Ernest W. Gates, D.M.D.

5. Jackson appliances, with patient. Wickham model trimmer. W. H. Gilpatric, D.M.D.

6. Correcting habits. Edward C. Hoey, D.M.D.

7. Case models. H. L. Howe, D.M.D.

8. Case models. Adelbert Johnson, D.M.D.

9. Technic for facial casts with articulate dental inserts. Herbert I. Margolis, D.M.D.

10. Case models. Ralph W. Short, D.M.D.

11. Case models. William J. Speers, D.M.D.

12. Case models. Raymond L. Webster, D.M.D.

Dr. Alfred Paul Rogers gave an informal talk on "Increased Function in the Treatment of Dental Anomalies." It was by far the best presentation Dr. Rogers ever gave dealing with the subject of muscle functions. A great many men in the profession had gained the idea that Dr. Rogers did not use orthodontic appliances in any stage of treatment, also that he did not employ intermaxillary rubbers. He stated that regulating appliances and intermaxillary rubbers were necessary to overcome mechanical interferences, after which time muscular activity and increased function became very important factors. It has long been known that muscular activity and muscular pressure were necessary to develop the supporting structures of the teeth. Dr. Rogers has done much for the orthodontic profession by explaining this fact. He also showed pictures which were made by Dr. W. R. Dinham, of Seattle, and Dr. Paul Lewis illustrating exercises. A great many of Dr. Lewis's friends were glad to see him in the movies.

Vilhjalmur Stefansson gave a talk on "Abolishing the Arctic." His experiences regarding the long continuation of a meat diet were especially interesting. Living under the conditions that the Eskimos do they apparently seem to suffer no physical ills from the continuation of meat diets of which fish seem to be the most used. The effect of such a limited diet on the health of an individual in different environment would be an interesting experiment. It is our belief that one advantage of a single article of food is that it discourages overeating. Overeating is one of the bad habits of the human family. Among the outstanding points in Mr. Stefansson's talk was that it was warm in the Arctic in the summer time; there was not perpetual snow, nor six months of night; fish heads and rotten fish make good food, and all Eskimos do not live in snow houses.

ORTHODONTIC NEWS AND NOTES

American Society of Orthodontists

The Twenty-eighth Annual Meeting of the American Society of Orthodontists will be held at Estes Park, Colorado, July 15-19, 1929.—General Chairman, Dr. Henry F. Hoffman, Majestic Building, Denver, Colo.

New York Society of Orthodontists Mid-Winter Meeting

The Mid-Winter meeting of the New York Society of Orthodontists will be held the morning and afternoon of December 12, 1928, at the Hotel Roosevelt, Madison Avenue, corner 45th Street, New York City.

An exceptionally attractive program has been arranged by the Executive Committee and all ethical members of the medical and dental profession are invited. Sessions open promptly at 9:30.

The usual luncheon will be served between the morning and afternoon sessions.

Note change of meeting place.

William C. Fisher, Secretary
501 Fifth Avenue, New York City.

Southwestern Society of Orthodontists

The Southwestern Society of Orthodontists will hold their annual meeting at Dallas, Texas, January 2, 3, 4, and 5, 1929. A cordial invitation is extended to all orthodontists and members of the dental and medical professions.

Paul G. Spencer, Secretary,
Waco, Texas.

The Eastern Association of Graduates of the Angle School of Orthodontia

The meetings for the season of 1928-1929 will be held at the Vanderbilt Hotel, New York City, on Monday and Tuesday, January 28 and 29, 1929, and the annual meeting, which will be a get-together meeting of the Angle School Alumni, will be held on Monday and Tuesday, May 6 and 7, 1929.

E. Santley Butler, Secretary,
576 Fifth Avenue, New York City.

Great Lakes Association of Orthodontists

The next regular meeting of the Great Lakes Association of Orthodontists will be held at the Commodore Perry Hotel, Toledo, Ohio, Wednesday, December 5, 1928. An all day session is planned in conjunction with the Ohio State Dental Society which convenes there that week. The orthodontic profession is cordially invited to attend. For further details, communicate with

Dr. E. N. Bach,
1307 Second National Bank Bldg.,
Toledo, Ohio.

American Dental Association

The Seventy-first Annual Session of the American Dental Association will be held in Washington, D. C., October 7, 8, 9, 10, and 11, 1929.

Harry B. Pinney, Secretary,
58 East Washington Street,
Chicago, Illinois.

Dental Society of the State of New York

The Dental Society of the State of New York will hold its sixty-first annual meeting at Rochester, New York, on May 15, 16, and 17, 1929.

For information with reference to the exhibits, write to E. G. Link, 226 Cutler Building, Rochester, New York; Clinics, John T. McIntee, Chairman, Cutler Building, Rochester, New York; Literary Exercises, etc., A. P. Burkhart, Secretary, 57 East Genesee Street, Auburn, New York.

The Dallas Mid-Winter Dental Clinic

The Dallas Mid-Winter Dental Clinic will be held February 11, 12, 13, 1929, in Dallas. The clinicians for this meeting are Dr. T. W. Maves, of Cleveland, Oral Surgery; Dr. James W. Crawford, of Milwaukee, Prosthetics; Dr. Menifee R. Howard, of Denver, Surgery; also a man of national repute in Orthodontia yet to be selected.

Notes of Interest

Dr. Charles S. Adelstien announces the opening of an office at 929 Rose Building, Cleveland, Ohio. Practice limited to orthodontia.

Dr. Richard H. Stucklen announces the removal of his offices to the Medical Arts Building, Wilmington, Delaware. Practice limited to orthodontia.

Dr. Edward Mason Griffin, formerly of Portland, Oregon, announces the removal of his office to 40 East 49th Street, Corner Madison, New York, to continue the practice of orthodontia exclusively.

Dr. Thomas M. Robertson announces the opening of a new office in the Columbia Building, Coffeyville, Kansas. Practice limited to orthodontia.

Dr. Victor H. Jackson will remove his offices on November 1, 1928, from 40 East 41st Street, to The Professional Center Building, 57 West 57th Street, New York, where he will continue his practice of orthodontia and orthopedia of the face.